Final Focused Feasibility Study for Site 5 Soils

162nd Fighter Group
Arizona Air National Guard
Tucson International Airport Superfund Site
Tucson, Arizona

November 1995

AIR NATIONAL GUARD

HQ/ANG/CEVR
Andrews AFB, Maryland

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Tucson, Arizona

November 1995

Prepared For:

HQ/ANG/CEVR
Andrews AFB, Maryland

Prepared By:

ERM

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FINAL

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Acronym	Definition
1,1,1-TCA	1,1,1-trichloroethane
1,1,2-TCA	1,1,2-trichloroethane
1,2-DCA	1,2-dichloroethane
AANG	Arizona Air National Guard
ADEQ	Arizona Department of Environmental Quality
AFB	Air Force Base
AFP	Air Force Plant
ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
ARARs	applicable or relevant and appropriate requirements
ARCC	Allowable Residual Contamination Concentration
bgs	below ground surface
CATOX	catalytic oxidizer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DRE	destruction removal efficiency
EPA	United States Environmental Protection Agency
ERM	ERM-West, Inc.
FFS	focused feasibility study
FG	Fighter Group
FS	feasibility study
GFO	good faith offer
GTI	Groundwater Technology, Inc.
HBGL	Health Based Guidance Levels
HMTC	Hazardous Materials Technical Center
IRP	Installation Restoration Program
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
ORNL/ETS	Oak Ridge National Laboratory/Environmental Technology Section
OS	Observation Squadron
OWS	oil water separator
PCE	tetrachloroethylene
POL	petroleum. oil, and lubricants
RI	remedial investigation
ROD	record of decision
SVE	soil vapor extraction
TBC	to-be-considered
TCE	trichloroethylene

ACRONYM LIST

Acronym	Definition
TIA	Tucson International Airport
TMV	toxicity, mobility, and volume
TPHCs	total petroleum hydrocarbon compounds
VOCs	volatile organic compounds
$\mu g/l$	micrograms per liter

EXECUTIVE SUMMARY

ERM-West, Inc., (ERM) has prepared this Focused Feasibility Study (FFS) Report for Site 5 soils at the Arizona Air National Guard (AANG) Base in Tucson, Arizona. The study is part of the Installation Restoration Program of the Air National Guard. The FFS was prepared to address remedial action alternatives for VOC contaminated soil at the AANG Base.

Previous studies at Site 5 indicate that concentrations of some volatile organic compounds (VOCs), including trichloroethylene (TCE), exist in soil underlying the site. The concentrations of these compounds were well below the United States Environmental Protection Agency's (EPA's) and Arizona Department of Environmental Quality's action levels in soils. Consequently no carcinogenic or noncarcinogenic health risks are expected based on direct exposure to Site 5 soils (i.e., exposure to surface soils). However, transport of VOCs from subsurface soils to ground water presents a potential source of health risk.

Analysis of potential transport of VOCs in subsurface soils suggests that the mass of these contaminants in Site 5 soils is sufficient to produce measurable concentrations in the upper subunit ground water. Therefore, TCE can potentially migrate to ground water at concentrations exceeding the EPA ground water cleanup goal of 5 micrograms per liter (μg/l). Based on the potential risk to ground water, a preliminary cleanup goal of 200 μg/l was established for TCE in soil vapor. This cleanup goal was established to protect the upper subunit ground water quality. The goal was based on analytical vadose zone transport modeling presented in this FFS.

EPA's Presumptive Remedy approach was used to streamline the evaluation and selection of remedial alternatives for Site 5 soils. This Presumptive Remedy approach was developed by the EPA based on its experience that many Superfund sites have similar characteristics, such as types of contaminants present, types of disposal practices, and environmental media affected by contaminants. The objective of the Presumptive Remedy approach is to use EPA's past experience to speed up selection of cleanup actions. EPA considers soil vapor extraction (SVE) the primary Presumptive Remedy at all sites with VOC contaminated soils.

Various site- and contaminant-specific factors were reviewed to evaluate the applicability of SVE to remediation of Site 5 soils. ERM also reviewed the results of case studies for similar sites throughout the country. The results of the technology screening analysis suggests that the types of contaminants present, distribution of contaminants, and soil physical parameters are amenable to remediation using SVE. In accordance with the EPA's guidance document entitled Presumptive *Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils* (EPA Directive 9355.0-48FS), only SVE was further evaluated.

Three SVE process options were evaluated as part of this FFS:

- SVE with Catalytic Oxidation (Alternative 2A);
- SVE with Activated Carbon (Alternative 2B); and
- SVE with No Off gas Treatment (Alternative 2C).

The No Action Alternative (Alternative 1) was also evaluated for comparison to SVE. The alternatives were evaluated against EPA's nine criteria and compared to one another. The results of the evaluation suggested that SVE with Activated Carbon (Alternative 2B) should be implemented at the site. A pilot SVE test will be conducted at Site 5. The results of the test will be used as the basis for a refined SVE treatment system design to be prepared during the Remedial Design Process.

SECTION 1.0

INTRODUCTION

1.1 Purpose and Organization of Report

ERM-West, Inc., (ERM) has prepared this focused feasibility study (FFS) Report for Site 5 soils at the Arizona Air National Guard (AANG) Base in Tucson, Arizona. The study is part of the Installation Restoration Program (IRP) of the Air National Guard (ANG). The work was performed under contract DAHA90-94-0014 between ERM and the National Guard Bureau, Departments of the Army and the Air Force.

The IRP has been implemented to investigate and remediate contaminated sites subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act. The principal components of the IRP for the AANG Base included the following:

- Preliminary Assessment Record Search performed in 1987; and
- Remedial Investigation performed during the period 1988 through 1994.

This FFS has been prepared to address remedial action alternatives for contaminated soil at the AANG Base. This FFS Report follows the format suggested in the following EPA guidance documents:

- *Interim Final Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA* (EPA, 1988); and
- *Presumptive Remedies: Policy and Procedures* (EPA, 1993a).

The report is organized into three sections. The first section presents a summary of the Presumptive Remedy approach as applied to this FFS. It also provides background information regarding the AANG Base and information regarding previous investigations at Site 5. The second section provides descriptions of soil remedial alternatives and presents process options and monitoring requirements. A discussion of applicable or relevant and appropriate requirements (ARARs) is also

discussed in section two. The third section provides a detailed analysis of soil remedial alternatives.

Two appendices are included with this FFS Report. Appendix A contains a summary of Oak Ridge National Laboratory/Environmental Technology Section's (ORNL/ETS's) numerical and analytical vadose zone modeling of volatile organic compounds (VOC) transport to ground water. Appendix B contains information regarding potential ARARs, as provided by the ADEQ. Appendix C contains cost estimates for remedial alternatives.

1.2 Presumptive Remedy Approach

EPA has developed an approach to streamline the evaluation and selection of site cleanup actions for contaminated soils and ground water at Superfund sites. This Presumptive Remedy approach was developed based on EPA's finding that certain categories of Superfund sites have similar characteristics, such as types of contaminants present, types of disposal practices, and environmental media affected by contaminants.

The objective of the Presumptive Remedy approach is to use EPA's past experience to speed up selection of cleanup actions. Over time, EPA expects that use of the Presumptive Remedy approach will ensure consistency in remedy selection and will reduce the cost and time required to clean up similar types of sites. EPA expects that the Presumptive Remedy will be used at all appropriate sites except under unusual site-specific circumstances. EPA has developed a series of directives to aid application of the Presumptive Remedy approach to various types of sites. The EPA directive applicable to the soil FFS for the AANG Base is entitled: *Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils* (September 1993).

1.3 Background Information

The following sections summarize background information for the AANG Base and Site 5.

1.3.1 Site Description

The AANG Base occupies the northwest corner of the Tucson International Airport (TIA), Tucson, Pima County, Arizona. The AANG Base, which is the headquarters for the 162nd Fighter Group (FG), is located at 1500 E. Valencia Road and currently occupies 84 acres. The TIA occupies approximately 2,600 acres 8 miles south of the Tucson central business district (Figure 1-1). The AANG Base is surrounded by land with a mixture of uses, including transportation, industrial, commercial, residential, and vacant land.

1.3.2 Base History

The past and current operations of the 162nd FG include aircraft maintenance; ground vehicle maintenance; petroleum, oil, and lubricants (POL) distribution and management; and fire training activities (on-site fire training activities ceased in 1965). The primary hazardous material on the AANG Base is JP-4 jet fuel which was replaced with JP-8 jet fuel in October 1993. Significant quantities of aviation gasoline, gasoline, and diesel fuel are also used on the AANG Base, as are smaller amounts of industrial solvents, paints, acids, hospital supplies, and pesticides. Typical wastes include contaminated fuels, spent solvents, off-specification materials, and dirty oils. Since 1992, waste oils generated by the AANG Base have been picked up by a contractor for recycling.

1.3.3 Previous Investigations

Several soil investigations or assessments have been performed on the sites located within the AANG Base (Figure 1-2). The following subsections summarize the scope and results of these investigations.

Groundwater Technologies, Inc. (GTI)

Groundwater Technologies, Inc.'s (GTI's) 1987 soil assessment at the former fire-training area (Site 1) on the AANG Base consisted of a drilling and sampling program to determine the impact of former fire-training activities on the soil underlying the site.

GTI drilled eight soil borings at Site 1. Samples from each borehole were composited, and a total of eight samples (one composite from each borehole) were submitted for analysis of total petroleum hydrocarbon compounds (TPHCs) utilizing EPA Method 418.1, volatile petroleum hydrocarbon compounds utilizing modified EPA Method

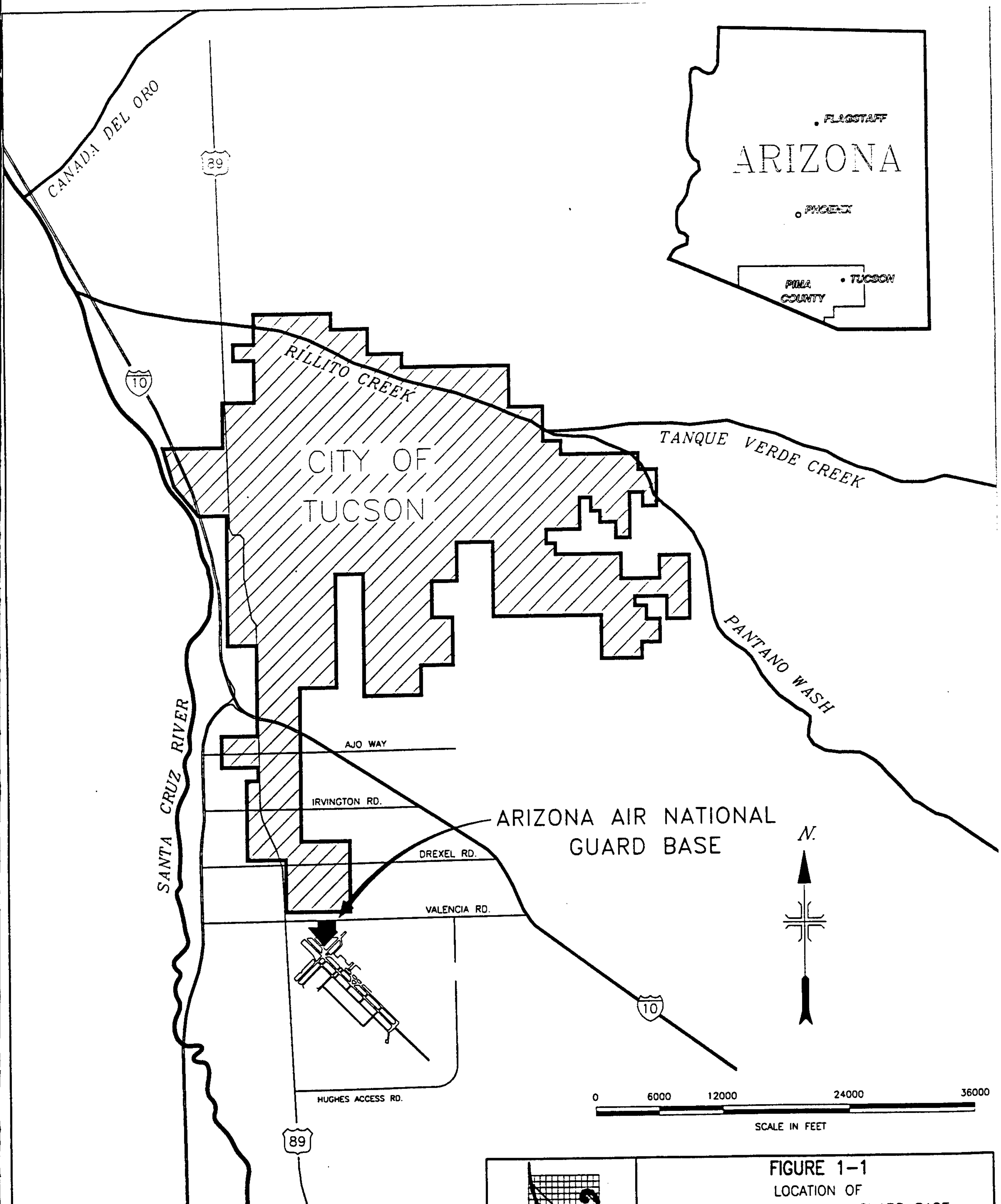

FIGURE 1-1
LOCATION OF
ARIZONA AIR NATIONAL GUARD BASE

Compiled by ERM from AANG RI Report, Draft Final – October 1994

DATE	SCALE	DRAWING NUMBER	JOB NUMBER
1-04-95	1" = 12000'	A-6003.21-07	6003.21

SIZE	SHEET	REV	ERM CAD ID NUMBER
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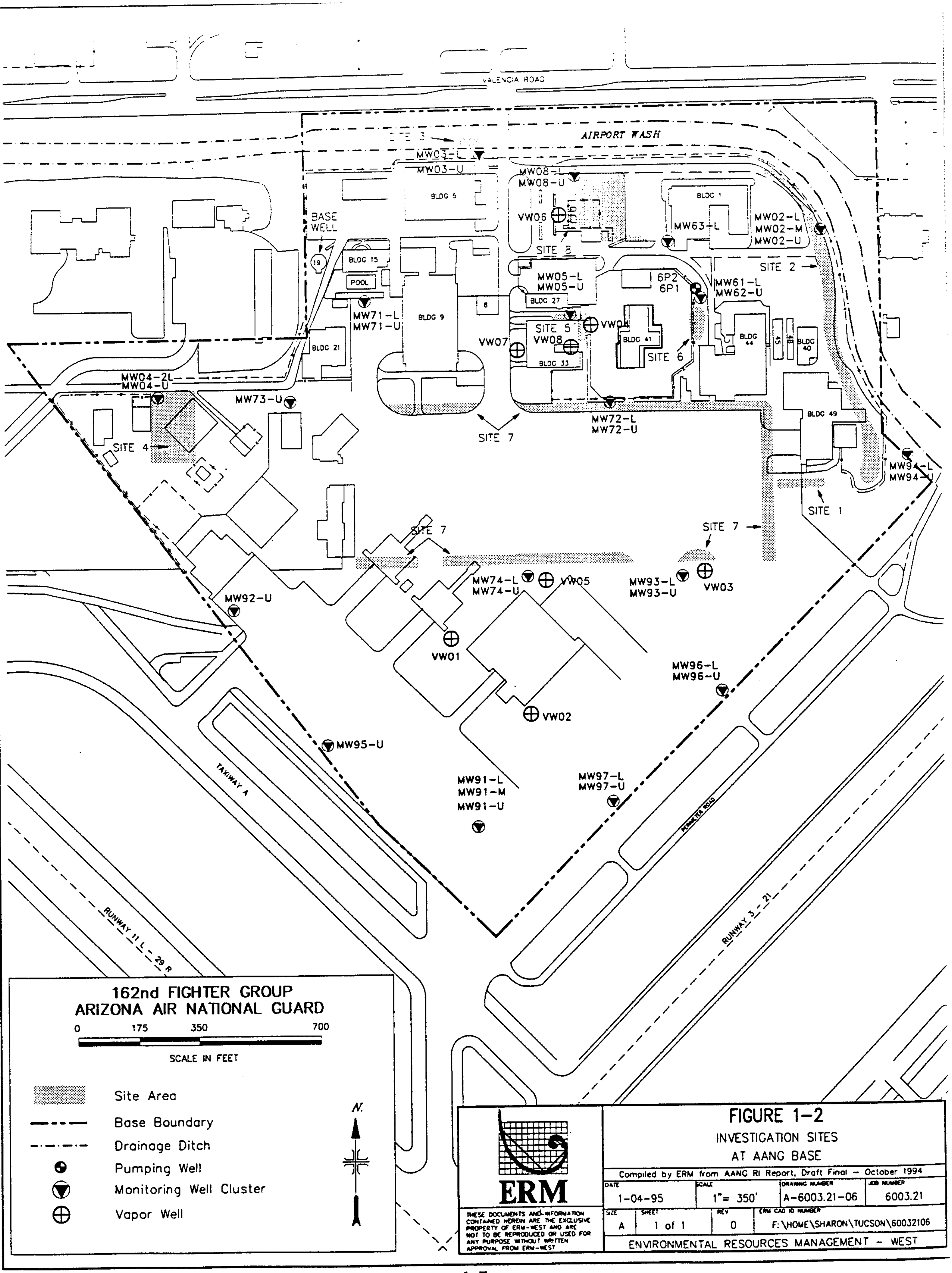
VALENCIA ROAD
AIRPORT WASH
SITE 3
MW03-L
MW03-U
MW08-L
MW08-U
BLDG 5
BLDG 1
BASE WELL
19
VW06
MW63-L
MW02-L
MW02-M
MW02-U
SITE 8
SITE 2
BLDG 15
POOL
MW05-L
MW05-U
6P2
6P1
MW61-L
MW62-U
BLDG 27
MW71-L
MW71-U
BLDG 9
SITE 5
VW04
VW08
VW07
BLDG 41
SITE 6
BLDG 44
BLDG 40
BLDG 21
BLDG 33
MW04-2L
MW04-U
MW73-U
MW72-L
MW72-U
BLDG 49
SITE 4
SITE 7
MW94-L
MW94-U
SITE 1
SITE 7
SITE 7
MW74-L
MW74-U
VW05
MW93-L
MW93-U
VW03
MW92-U
VW01
MW96-L
MW96-U
VW02
MW95-U
TAXIWAY A
MW91-L
MW91-M
MW91-U
MW97-L
MW97-U
PERIMETER ROAD
RUNWAY 11 L - 29 R
RUNWAY 3 - 21
162nd FIGHTER GROUP
ARIZONA AIR NATIONAL GUARD
0 175 350 700
SCALE IN FEET
Site Area
Base Boundary
Drainage Ditch
Pumping Well
Monitoring Well Cluster
Vapor Well
N
ERM
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FIGURE 1-2
INVESTIGATION SITES
AT AANG BASE
Compiled by ERM from AANG RI Report, Draft Final - October 1994
DATE 1-04-95
SCALE 1"= 350'
DRAWING NUMBER A-6003.21-06
JOB NUMBER 6003.21
SIZE A
SHEET 1 of 1
REV 0
ERM CAD ID NUMBER F:\HOME\SHARON\TUCSON\60032106
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8015, and total aromatic and nonhalogenated VOCs utilizing EPA Method 8020.

The GTI study found that low concentrations of TPHCs existed in Site 1 soils, however, VOCs were not detected in the samples.

Preliminary Assessment Records Search by Hazardous Material Technical Center (HMTC)

HMTC performed the records search portion of the IRP in 1987 by conducting a review of pertinent installation documents, personal interviews with 28 AANG Base employees, and an inspection of the AANG Base. The interviews and research resulted in the identification of eight potentially contaminated sites, which were rated with the Air Force's Hazard Assessment Rating Methodology. The eight sites (Figure 1-2) were as follows:

- Site 1, Old fire-training area (south of Building 49);
- Site 2, Solvent-dumping area, east fence line (east of Building 49 along Airport Wash);
- Site 3, Storm drain discharge point, gatehouse (north of the Gatehouse);
- Site 4, AANG Base parking lot, west (east of Building 48);
- Site 5, Old wash rack area (east end of Building 33);
- Site 6, Solvent-dumping area (east of Building 41);
- Site 7, Edges of aircraft parking apron (north, east, and south edges of main aircraft parking apron); and
- Site 8, POL area (fenced area north of Building 27).

Remedial Investigation by ORNL/ETS

The RI field investigation began in April 1989 to define the hydrogeologic setting and characterize the presence and extent of contaminants resulting from past activities at Sites 1 through 8. The field investigation included:

- Review of aerial photographs and past activities at the AANG Base;
- Conducting soil vapor surveys comprised of 129 shallow soil vapor samples;

- Drilling and sampling 15 soil borings;
- Installing 37 monitoring wells and eight multiple completion vapor wells;
- Collecting 10 rounds of ground water samples from monitoring wells; and
- Aquifer testing.

The results of the RI were summarized in ORNL/ETS's report entitled: *Final Remedial Investigation Report, 162nd Fighter Group, Arizona Air National Guard, Tucson, Arizona* (June 1995). In this report, ORNL/ETS provided data to demonstrate that the upper regional aquifer underlying the AANG Base is divided into two major subunits: the upper and lower subunits. A unit identified as the middle aquitard separates the upper and lower subunits. This unit is of significantly lower permeability compared to the upper and lower subunits. Along the eastern and western margins of the AANG Base; the middle aquitard is divided by discontinuous, permeable lenses referred to as the middle subunit. Ground water underlying the AANG Base follows the general surface drainage pattern and flows northwest. Ground water flow rates range from 700 feet per year in the lower subunit to nearly 800 feet per year in the upper subunit.

ORNL/ETS collected ground water samples from monitoring wells constructed during RI activities in order to identify potential contaminants and to determine the extent of ground water contamination. Trichloroethylene (TCE) was detected in ground water samples collected from the upper and lower subunits. The maximum TCE concentrations detected in ground water samples collected from upper and lower subunit monitoring wells have been 46 and 41 μg/l, respectively. TCE detections in ground water collected from the upper and lower subunit define a plume that extends from the southeast to the northwest across the AANG Base.

TCE was detected in ground water samples collected from upgradient upper and lower subunit monitoring wells at the AANG Base at concentrations exceeding EPA's ground water cleanup goal of 5 micrograms per liter (μg/l). The only evidence of an on-base contribution of TCE to ground water was found at Site 5. ORNL/ETS determined that vapor-phase TCE in soils at Site 5 were contributing approximately 5 μg/l to upper subunit ground water.

In the Final RI Report, ORNL/ETS concluded that Site 5 had a relatively minor impact on chemical quality of ground water in the

upper subunit and recommended a feasibility study for VOCs in soil at Site 5.

1.3.4 Site 5 Background Information

The following sections provide background information regarding Site 5, including: site description, site history, previous investigations, and environmental conditions.

Site Description

The configuration of Site 5, as described in the preliminary assessment (HMTC, 1987), consists of a 10-ft-wide strip along the northern and eastern sides of Building 33 (Figure 1-3). Underneath the eastern strip lies the new oil/water separator (OWS) and sanitary sewer line that connects with the older sanitary sewer line running parallel to the northern side of Building 33. The old wash rack area is now covered by the northeast corner of Building 33. The site is covered by pavement and concrete and is used for storage of surplus equipment from the munitions group.

Site History

Site 5 served as a wash rack area for the engine shop and aircraft maintenance shops from 1959 to 1985. The old wash rack has reportedly always been connected to the sanitary sewer. In 1980, the wash rack drain was connected to an OWS that also discharges to the sanitary sewer system. Use of the OWS was discontinued in 1985. Although most of the wastes from Site 5 were discharged into the sanitary sewer, the presence of strong petroleum hydrocarbon odors in soil excavated during construction activities at this site were reported by persons interviewed during the preliminary assessment. These reports suggested that leaks from the sanitary sewer network that discharges from this site are potential contaminant pathways to the surrounding soil. Possible contaminants at this site were identified as PD-680 solvent, TCE, and oils.

In an effort to clarify the ambiguity of the historical information, additional field reconnaissance and interviews with AANG Base personnel were conducted. ORNL/ETS personnel learned that a hot-vapor degreaser tank was used to clean aircraft weapons over a period of approximately 3 years in the early 1970s. Spent solvent and sludge from the vapor tank were drained into the old wash rack by lifting the tank with a forklift and tipping it over into the old wash rack. Based

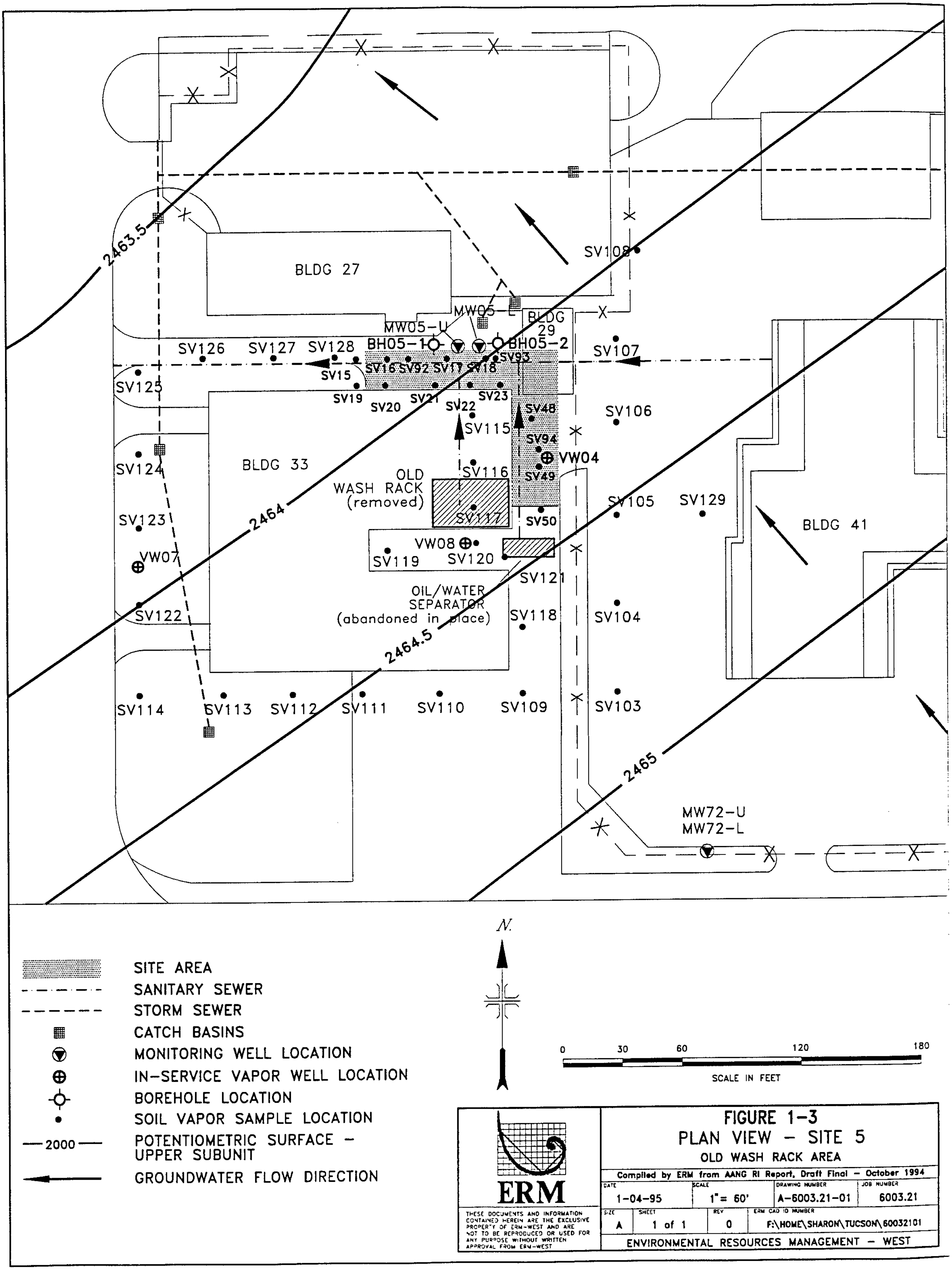
BLDG 27
BLDG 29
BLDG 33
BLDG 41
MW05-U
MW05-L
BH05-1
BH05-2
SV126
SV127
SV128
SV15
SV16
SV92
SV17
SV18
SV93
SV19
SV20
SV21
SV22
SV23
SV48
SV94
VW04
SV49
SV50
SV107
SV108
SV106
SV105
SV129
SV125
SV124
SV123
VW07
SV122
SV115
SV116
SV117
OLD WASH RACK (removed)
VW08
SV119
SV120
SV121
OIL/WATER SEPARATOR (abandoned in place)
SV118
SV104
SV114
SV113
SV112
SV111
SV110
SV109
SV103
MW72-U
MW72-L
2463.5
2464
2464.5
2465
N
SITE AREA
SANITARY SEWER
STORM SEWER
CATCH BASINS
MONITORING WELL LOCATION
IN-SERVICE VAPOR WELL LOCATION
BOREHOLE LOCATION
SOIL VAPOR SAMPLE LOCATION
2000
POTENTIOMETRIC SURFACE - UPPER SUBUNIT
GROUNDWATER FLOW DIRECTION
0
30
60
120
180
SCALE IN FEET
ERM
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FIGURE 1-3
PLAN VIEW - SITE 5
OLD WASH RACK AREA
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DATE 1-04-95
SCALE 1" = 60'
DRAWING NUMBER A-6003.21-01
JOB NUMBER 6003.21
SIZE A
SHEET 1 of 1
REV 0
ERM CAD ID NUMBER F:\HOME\SHARON\TUCSON\60032101
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on the figures provided to ORNL/ETS personnel, an estimated 3,000 gallons of waste solvent [primarily TCE but tetrachloroethylene (PCE) may also have been used] were disposed of in the former wash rack drain.

Surface-Water Hydrology

Due to the flat topography, surface runoff at Site 5 occurs predominantly as sheet flow. Runoff flows to the north, where it is intercepted by one of several storm drain catch basins located north and east of Building 27.

Geology

Two monitoring wells and three vapor wells were installed at Site 5: monitoring wells MW05-U and MW05-L; and vapor wells VW04, VW07, and VW08. Geologic information for Site 5 was obtained based on data collected during drilling of these wells.

Site 5 surface soils have been altered by construction, making identification difficult. The subsurface soils consist of unsaturated sands and silty sands deposited in cyclic intervals. The vadose zone extends from ground surface to approximately 88 feet below ground surface (bgs) and consists of silty sands, caliche deposits of varying induration, and gravelly sands.

Underlying these sediments are two sand units, the upper and lower subunits of the upper regional aquifer. The upper subunit at Site 5 is composed of well graded, light-brown, gravelly, coarse sand. The upper subunit sand at Site 5 is coarser than upper subunit sand at other sites and is generally silt-free. The upper subunit at Site 5 is encountered at about 88 feet bgs.

The middle aquitard separates the upper and lower subunits and is composed of tight sandy silt with scattered pebbles. The middle aquitard at Site 5 is encountered at 103 feet bgs. Caliche cementation is prevalent in the interval of 108 to 110 feet bgs of the middle aquitard. The lower subunit at Site 5 is encountered at 128 feet bgs and is underlain by the basal aquitard consisting of clayey silt. The basal aquitard, identified as the regional aquitard, is encountered at approximately 138 feet bgs.

Hydrogeology

The hydrogeologic interpretation for Site 5 is based on information obtained from the well-pair MW05. Both the upper and lower subunits are presently underlying Site 5. The upper subunit is

approximately 9 to 11 feet thick, which is greater than the average thickness of this unit at other locations at the AANG Base. The lower subunit is approximately 9 to 11 feet thick, about the average thickness of this unit at other locations at the AANG Base.

As shown in Figure 1-3, ground water flow direction at Site 5 is to the northwest at a gradient of approximately 0.005 feet/feet. The upper and lower subunits appear to exhibit semiconfined and confined conditions across the AANG Base.

Demographics and Land Use

Site 5 is located in the north-central part of the AANG Base. The nearest residence lies approximately 500 feet north of the AANG Base's northern boundary along Valencia Road. Land use north of the AANG Base is a mixture of light industrial, commercial, and residential.

Ecology

The area encompassed by Site 5 is covered by pavement and concrete, with no natural vegetation or wildlife present.

Surface Features

The surface features at Site 5 consist of flat, paved surfaces surrounded by various buildings.

1.3.5 Site 5 Nature and Extent of Contamination

The following sections summarize the nature and extent of contamination in soil and ground water at the AANG Base. The text in these sections are excerpted from ORNL/ETS's *Final Remedial Investigation Report* (June 1995).

Soil

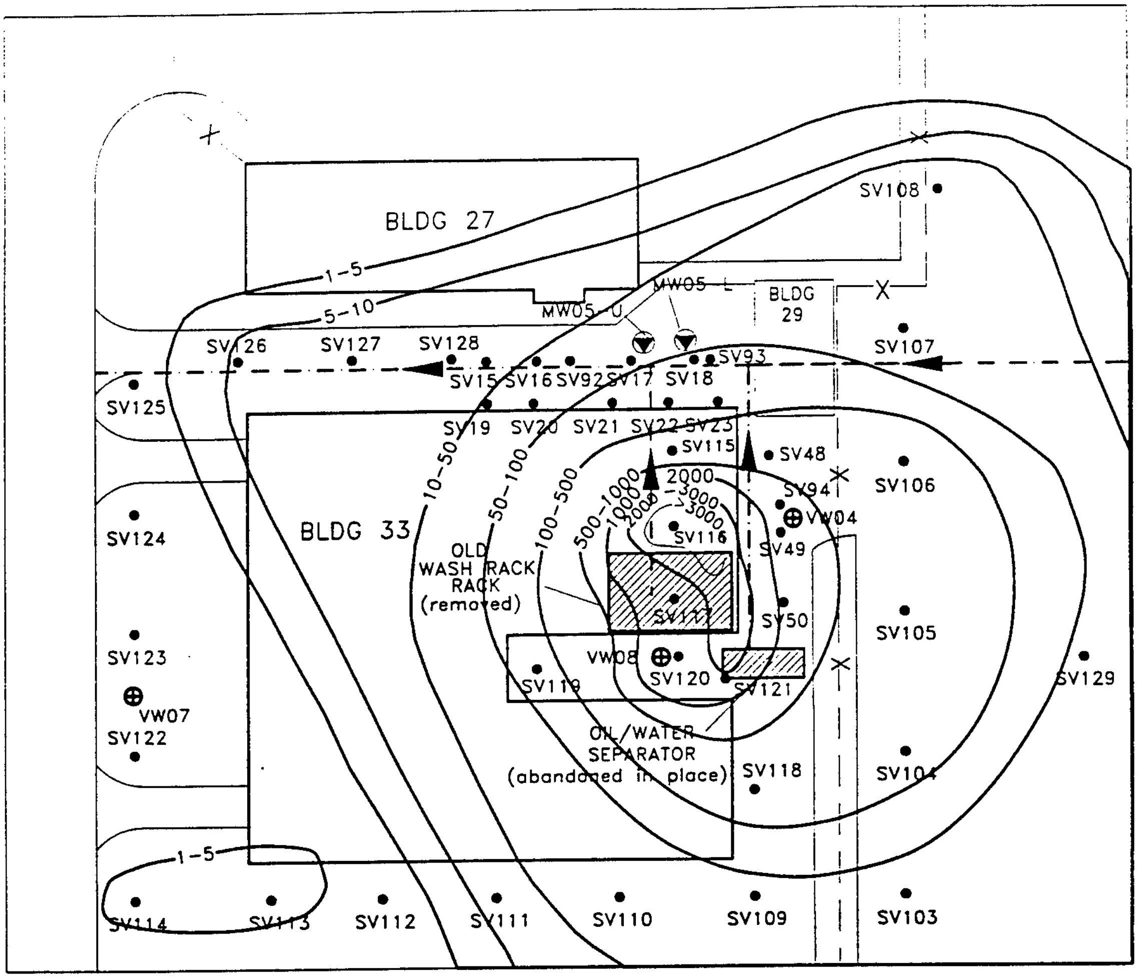
TCE, PCE, 1,1,2-trichloroethane (1,1,2-TCA), 1,1,1-trichloroethane (1,1,1-TCA), and 1,2-dichloroethane (1,2-DCA) were detected in one or more soil or soil gas/vapor samples collected from sampling locations within Site 5 (Table 1-1). ORNL/ETS prepared isoconcentration maps illustrating the distribution of TCE, PCE, and 1,1,1-TCA in shallow soil vapor samples collected during the RI (Figures 1-4 through 1-6). The shallow soil vapor samples were collected at depths of less than 10 feet bgs. ERM prepared a vertical profile (Figure 1-7) to illustrate the distribution of total VOCs in soil vapor samples collected from the

TABLE 1-1

Site 5 Soil and Ground Water Data Summary

Volatile Organic Compound	Maximum Concentrations Detected in RI Samples				
	Soil Samples (µg/kg)	Shallow Soil Gas Samples (µg/l in air)	Deep Soil Vapor Samples (µg/l in air)	Upper Subunit Ground Water Samples (MW05-U) (µg/l)	Lower Subunit Ground Water Samples (MW05-L) (µg/l)
TCE	250	3,036	1,750	11.0	5.4
PCE	25	83	83	0.38	ND
1,1,1-TCA	130	55	25	ND	ND
1,1,2-TCA	8.0	--	--	ND	ND
1,2-DCE	8.5	ND	ND	ND	ND

µg/l = micrograms per liter
µg/kg = micrograms per kilogram
TCE = Trichloroehylene
PCE = Tetrachloroethylene
1,1,1-TCA = 1,1,1-Trichloroethane
1,1,2-TCA = 1,1,2-Trichloroethane
1,2-DCA = 1,2-Dichloroethane
-- = not analyzed
Ground water samples collected during the period 6/89 through 10/94



SITE 5
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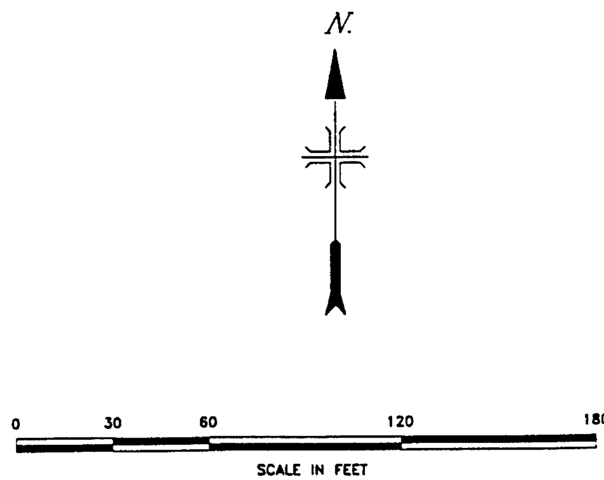

LEGEND

- MONITORING WELL LOCATION
- IN-SERVICE VAPOR WELL LOCATION
- SOIL VAPOR SAMPLE LOCATION
- SANITARY SEWER
- 3000 TCE in shallow soil vapor (ug/L)

ERM	FIGURE 1-4 DISTRIBUTION OF TCE IN SHALLOW SOIL VAPOR AT SITE 5		
	Compiled by ERM from AANG RI Report, Draft Final - October 1994		
	DATE 1-04-95	SCALE 1" = 60'	DRAWING NUMBER A-6003.21-02 / JOB NUMBER 6003.21
	SIZE A / SHEET 1 of 1	REV 0	ERM CAD ID NUMBER F:\HOME\SHARON\TUCSON\60032102
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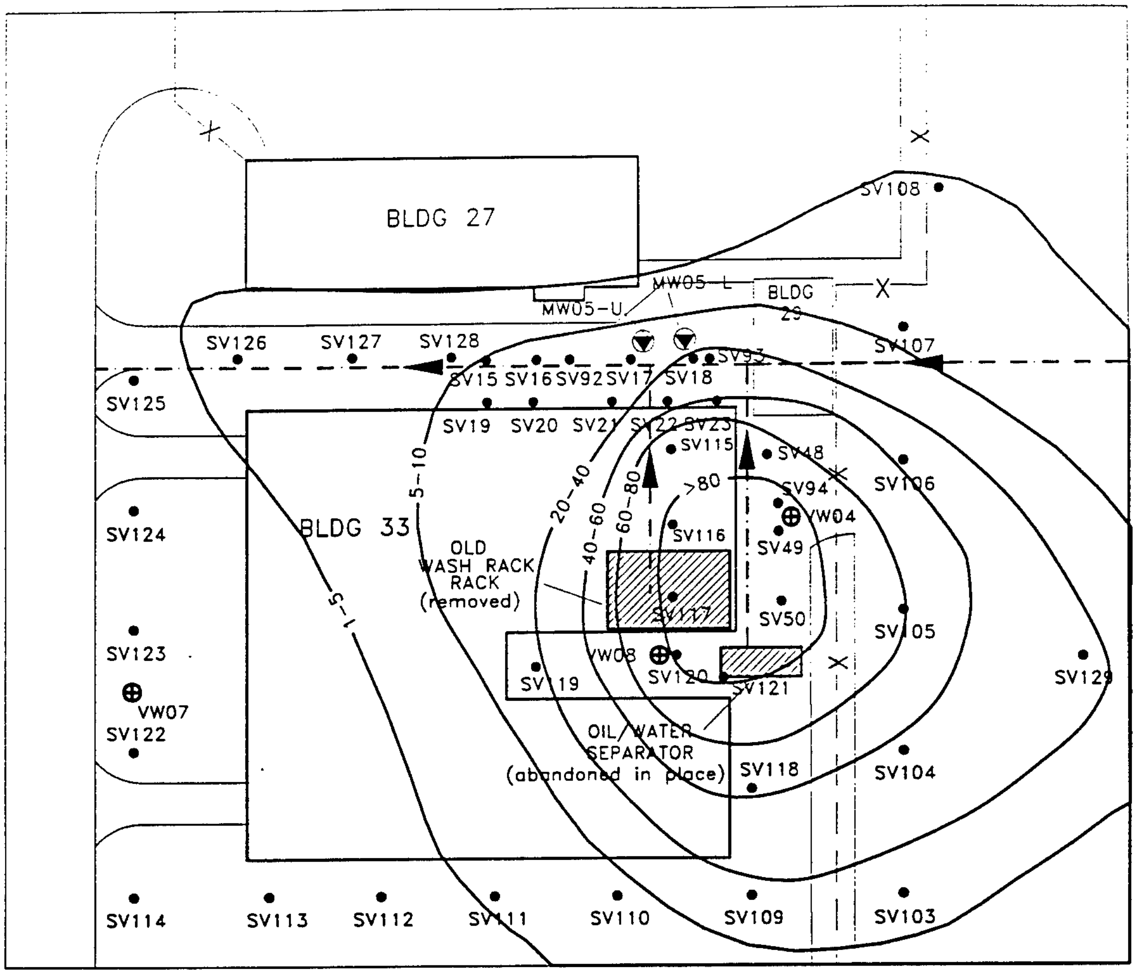

SITE 5
162nd FIGHTER GROUP
ARIZONA AIR NATIONAL GUARD

N.

LEGEND

- MONITORING WELL LOCATION
- IN-SERVICE VAPOR WELL LOCATION
- SOIL VAPOR SAMPLE LOCATION
- SANITARY SEWER
- >80 PCE in shallow soil vapor (ug/L)

0 30 60 120 180
SCALE IN FEET

ERM

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FIGURE 1-5
DISTRIBUTION OF PCE IN
SHALLOW SOIL VAPOR AT SITE 5

Compiled by ERM from AANG RI Report, Draft Final - October 1994

DATE	SCALE	DRAWING NUMBER	JOB NUMBER
1-04-95	1" = 60'	A-6003.21-03	6003.21

SIZE	SHEET	REV	ERM CAD ID NUMBER
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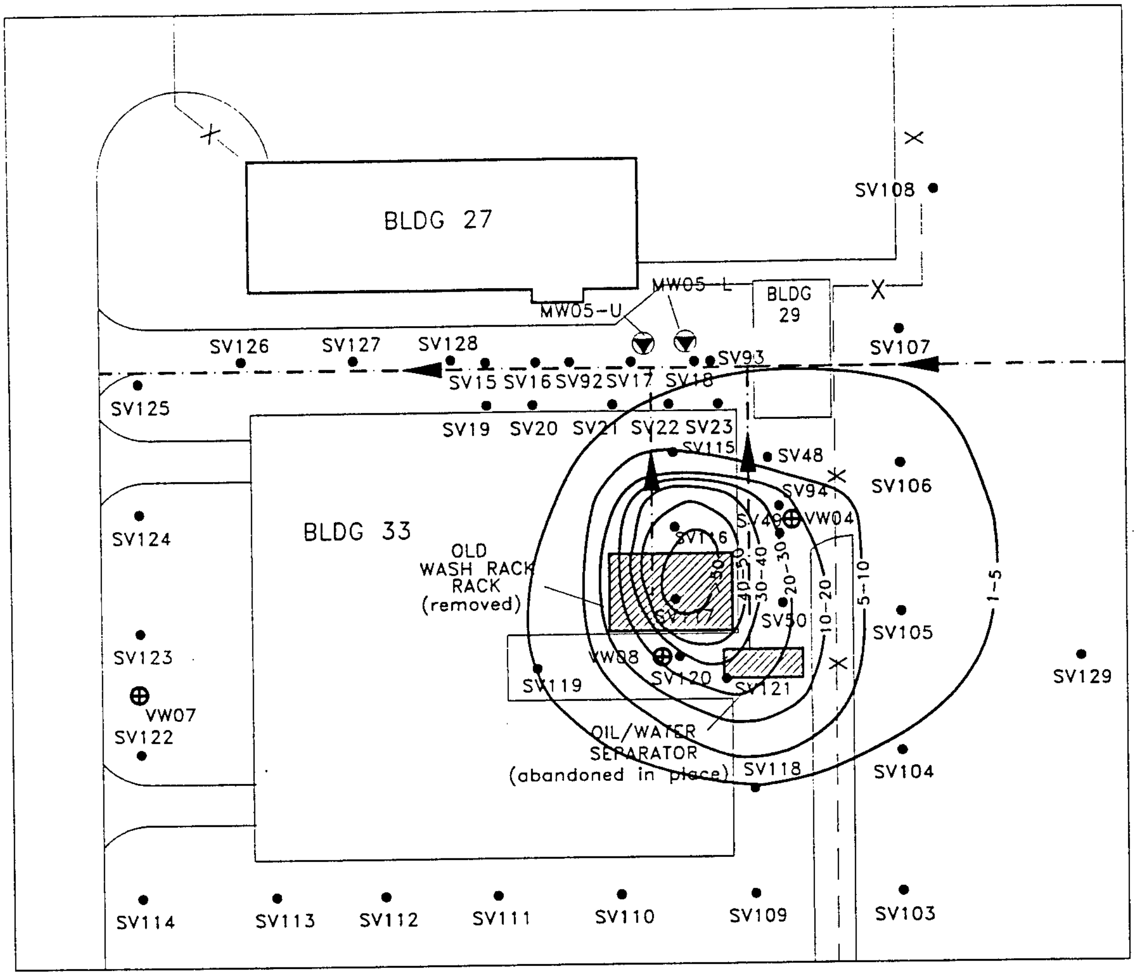
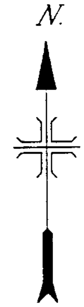
ENVIRONMENTAL RESOURCES MANAGEMENT - WEST

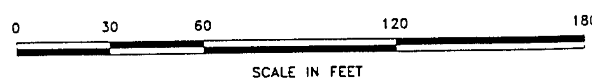


SITE 5
162nd FIGHTER GROUP
ARIZONA AIR NATIONAL GUARD

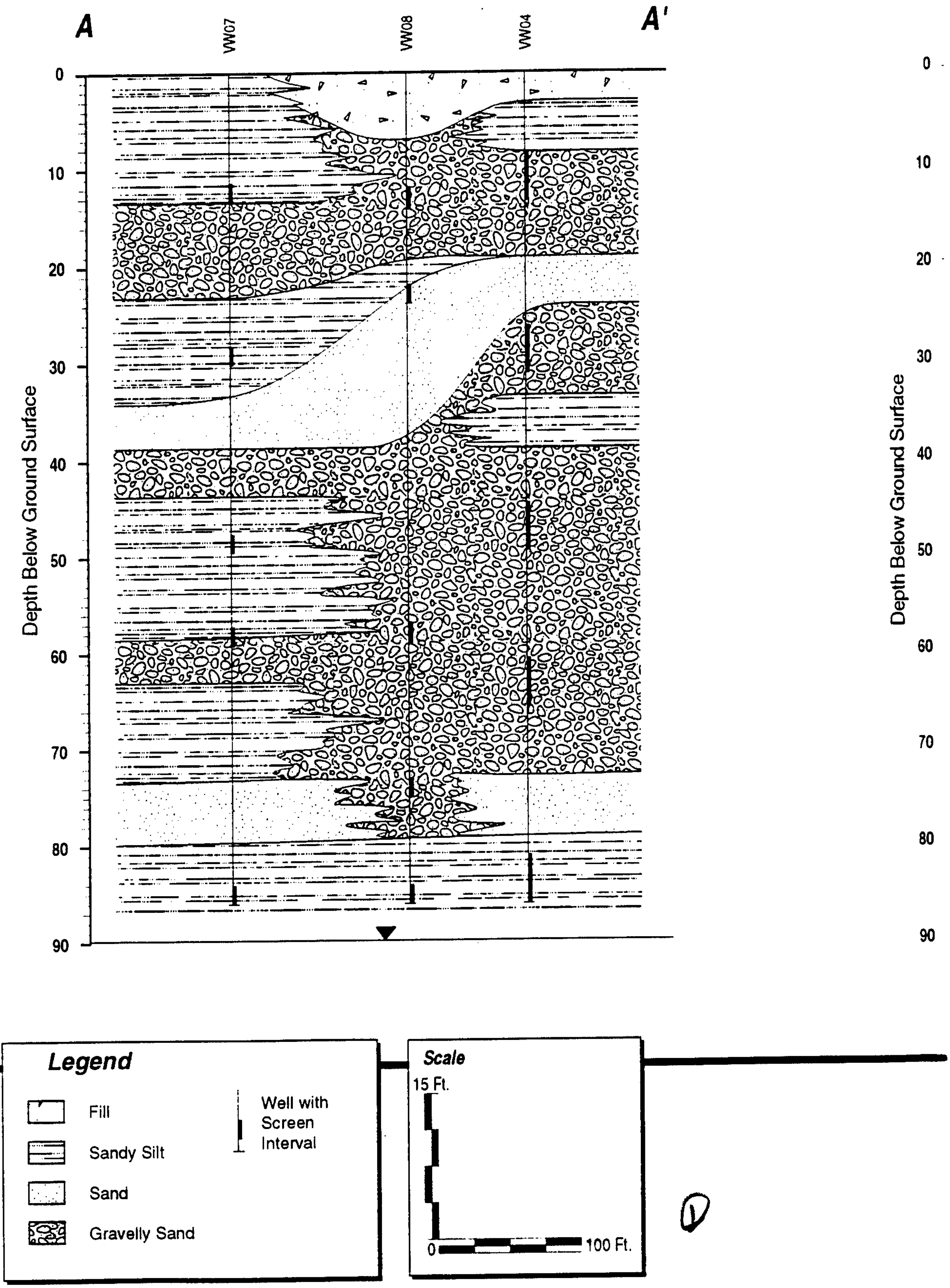


LEGEND

- MONITORING WELL LOCATION
- IN-SERVICE VAPOR WELL LOCATION
- SOIL VAPOR SAMPLE LOCATION
- SANITARY SEWER
- >50 — 1,1,1TCA in shallow soil vapor (ug/L)



ERM	FIGURE 1-6 DISTRIBUTION OF 1,1,1,TCA IN SHALLOW SOIL VAPOR AT SITE 5			
	Compiled by ERM from AANG RI Report, Draft Final - October 1994			
	DATE 1-04-95	SCALE 1"= 60'	DRAWING NUMBER A-6003.21-04	JOB NUMBER 6003.21
	SIZE A	SHEET 1 of 1	REV 0	ERM CAD ID NUMBER F:\HOME\SHARON\TUCSON\60032104
THESE DOCUMENTS AND INFORMATION CONTAINED HEREIN ARE THE EXCLUSIVE PROPERTY OF ERM-WEST AND ARE NOT TO BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT WRITTEN APPROVAL FROM ERM-WEST	ENVIRONMENTAL RESOURCES MANAGEMENT - WEST			


A
A'
VW07
VW08
VW04
Depth Below Ground Surface
0
10
20
30
40
50
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70
80
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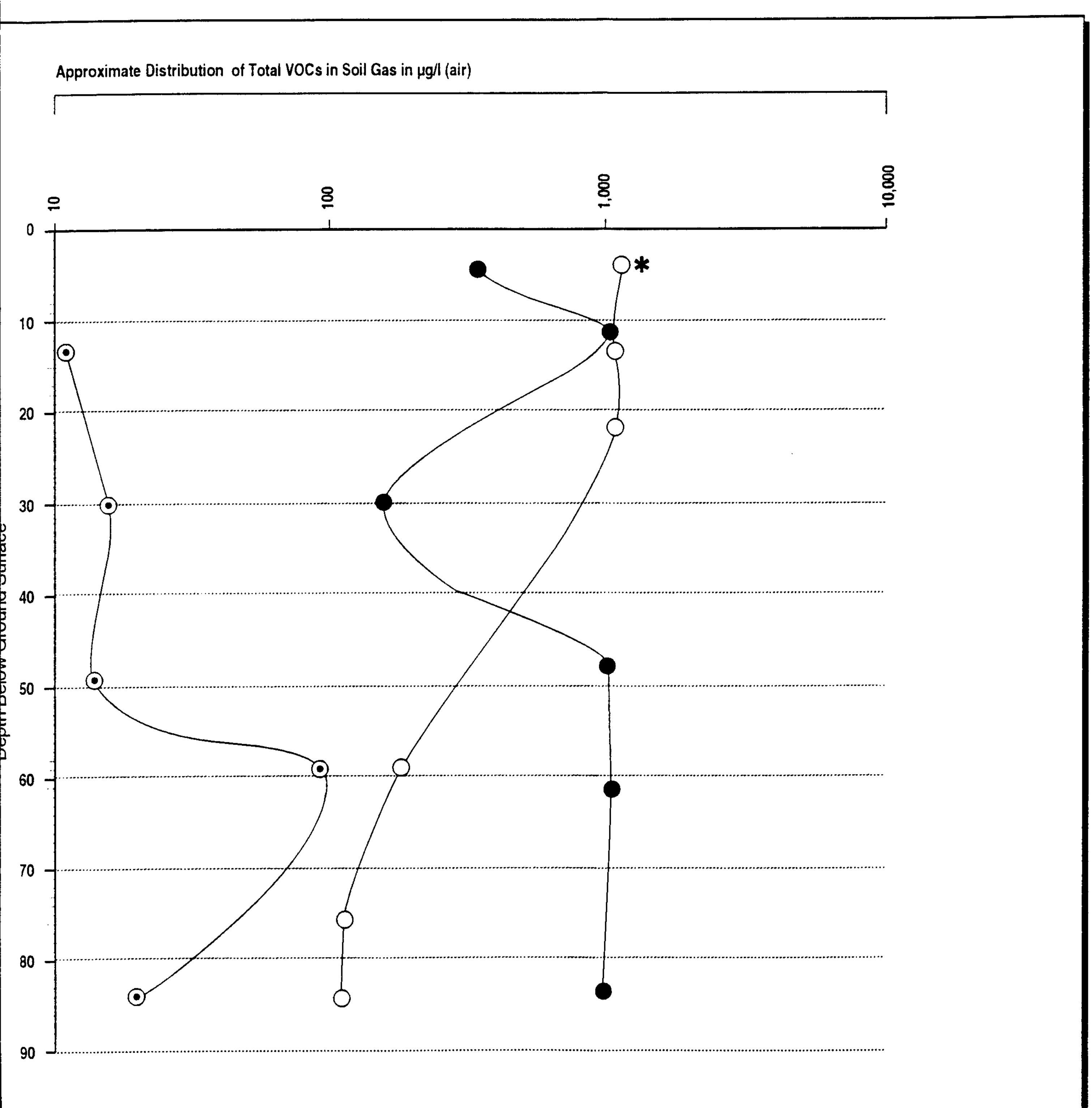
Legend
Fill
Sandy Silt
Sand
Gravelly Sand
Well with Screen Interval
Scale
15 Ft.
0
100 Ft.



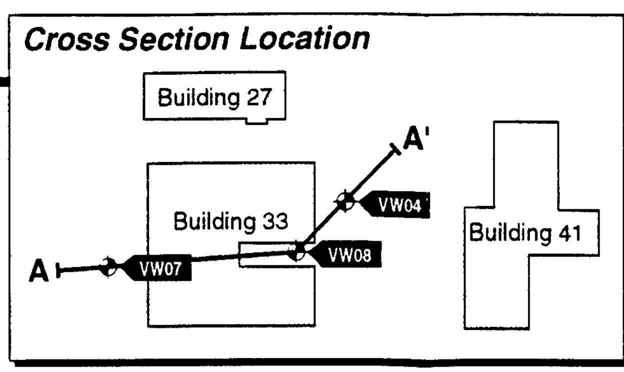


Figure 1-7

Vertical Distribution of Total VOCs in Site 5 Soil Vapor AANG-Tucson

ERM-West, Inc. 12'94
6004.21/GCF/12.21.94

multi-level vapor monitoring wells located at Site 5 (VW04, VW07, and VW08). Review of the vertical profile data suggests the following:

- Total VOC concentrations in soil vapor are generally greater in shallow soils (less than 10 ft bgs) than in soil vapor samples collected throughout the rest of the vadose zone.

- The highest VOC concentrations in deeper (below 10 ft bgs) soil vapor samples were detected at vapor monitoring well VW04. Soil vapor concentrations at the deepest interval monitored, approximately 84 feet bgs, averaged approximately 1,000 µg/l in air.

- The vertical distribution of VOC concentrations in the vadose zone is highly variable within Site 5.

Upper Subunit Ground Water

TCE and PCE have been detected in ground water samples collected from upper subunit monitoring well MW05-U. The source of TCE to the upper subunit ground water at Site 5 is apparently the result of a combination of sources. One source is the vapor-phase contamination associated with the old wash rack area. Comparison of TCE concentrations in upper subunit ground water samples collected from monitoring wells upgradient and downgradient of Site 5 suggests that the vapor-phase contaminants identified at Site 5 may be contributing approximately 5 µg/l of TCE and less than 1 µg/l of PCE to the upper subunit ground water.

The absence of 1,1,1-TCA, 1,1,2-TCA, or 1,2-DCA in upper subunit ground water suggests that the total mass of these compounds in the Site 5 vadose zone is insufficient to contribute measurable quantities due to the effects of dilution. The low levels of TCE and PCE in ground water, however, suggest that the mass of these contaminants is sufficient to produce measurable concentrations in the upper subunit ground water.

Lower Subunit Ground Water

TCE has been detected in samples collected from lower-subunit monitoring well MW05-L (Table 1-1). Several factors suggest that the source of TCE in lower subunit ground water is located upgradient of Site 5. The declining TCE concentrations in MW05-L implies that the vapor-phase TCE contamination, apparently affecting upper subunit ground water quality, is not reaching the lower subunit. This is due, primarily, to the high rate of ground water flow in the upper subunit and, secondarily, to the restrictive nature of the intervening middle aquitard. Additionally, TCE concentrations in lower subunit ground

water generally increase in successive monitoring wells located upgradient of Site 5.

1.3.6 Contaminant Fate and Transport

Contaminant fate and transport is discussed below.

Contaminant Persistence

ORNL/ETS performed a literature review regarding environmental fate of TCE, PCE, and 1,1,1-TCA in soil and ground water. They compared the results of the review to the data collected during the RI. The results of this comparison indicated that the three VOCs are not being actively biodegraded in either soil or ground water at the AANG Base.

Potential Routes of Migration

The potential route of exposure to a receptor from contamination at Site 5 is by migration through the vadose zone to the ground water of the upper and lower subunits or by vapor emissions to the ground surface and into the indoor air of adjacent buildings. Laboratory analyses indicate that there is quantifiable contamination in the soil at this site.

Contaminant Migration

The low concentration of VOCs in the soil samples and significantly higher vapor VOC concentrations in the vadose zone at this site indicate that most of the contaminants are in the vapor phase and are not readily adsorbed by the soil matrix due to the low organic content of alluvial materials. The highest quantifiable levels in the soil samples are associated with the fine-grained material where the contaminants are bound by residual moisture in the soil at very low concentrations. ORNL/ETS performed analyses of potential mass transfer of contaminants from the vadose zone underlying the site to upper subunit ground water. A summary of the ORNL analyses is included in Appendix A. The results of the analyses indicate that vadose zone transport of TCE could be responsible for contributing low concentrations of TCE to upper subunit ground water.

The TCE concentration gradient in the upper subunit ground water indicates that a contaminant plume is likely to be migrating through and downgradient of Site 5. The TCE concentration gradient in the lower-subunit ground water indicates the likelihood of a contaminant plume migrating from an off-AANG Base upgradient source, under

Site 7, and then under and downgradient of Site 5. The absence of any TCE-related degradation compounds in the ground water suggests that the only factor affecting the migration of TCE is ground water movement.

1.3.7 Preliminary Risk Assessment

This section describes the public health and environmental concerns resulting from Site 5. The contaminants identified at this site are 1,1,1-TCA, PCE, and TCE; however, only TCE was found in ground water of the upper and lower subunits.

Exposure Assessment

Air. ORNL/ETS evaluated potential for air emissions at this site using a hand-held survey meter at ground level. ORNL/ETS concluded that no emissions were occurring at Site 5. Additional analyses were performed to assess the potential risk to human health associated with the indoor pathway. The results of the analyses indicated there is no risk associated with the indoor air pathway.

Ground Water. There are low TCE concentrations in ground water underlying Site 5. TCE concentrations in the upper subunit ground water range from 0.8 to 8.5 µg/l. TCE concentrations in the lower subunit ground water range from 2.7 to 5.4 µg/l. At present, there are two private water-supply wells and two monitoring wells located one-half mile downgradient of Site 5. The TCE concentrations in samples collected from these wells range from nondetectable to 0.3 µg/l, a value less than the EPA's ground water cleanup goal of 5 µg/l. TCE concentrations in samples collected from monitoring wells MW03-L and MW03-U, also located downgradient of Site 5 but within the AANG Base boundary, also are currently less than 5 µg/l. TCE concentrations in samples collected from these wells currently range from nondetectable to 1.4 µg/l.

Surface Water. There is no naturally occurring surface water near this site except for runoff from infrequent precipitation. Moreover, due to the downward gradients observed in the upper subunit aquifer, ground water is not likely to discharge to surface water. Therefore, there is no exposure associated with surface water.

Soil. Low concentrations of TCE, PCE, 1,2-DCA, 1,1,1-TCA, and 1,1,2-TCA were detected in the soil at this site. Additionally, vapor-phase contaminants (1,1,1-TCA, TCE, and PCE) were documented by the soil-vapor investigations.

Risk Evaluation

None of the contaminant levels found in soil exceed the EPA's action levels in soil (40 CFR Part 264 Subpart S) or the ADEQ's Health Based Guidance Levels (HBGLs). The respective action levels and HBGLs for PCE, TCE, 1,2-DCA, 1,1,2-TCA, and 1,1,1-TCA are well above the concentrations of these compounds detected at this site, as discussed in Section 2.1.1 of this FFS. Consequently, there is no carcinogenic or non-carcinogenic health risks from direct exposure to soil at Site 5 (i.e., exposure to surface soils).

Transport of VOCs from subsurface soils to ground water presents a potential source of health risk associated with Site 5. Observed contamination in ground water of the upper and lower subunits exceeds the EPA's ground water cleanup goal of 5 µg/l and may present a potential risk to the public and environment. EPA has adopted a policy with regards to soil remediation in the TIA Superfund site that requires each contaminant be removed from soils until an Allowable Residual Contamination Concentration (ARCC) is achieved. The ARCC is defined as the concentration of a contaminant that will not cause or contribute to ground water contamination in excess of site ground water cleanup goals.

ERM used the VLEACH/mixing cell method to compute a preliminary estimate of the ARCC for TCE in soil at Site 5. The evaluation was performed using simplifying assumptions regarding the areal and vertical extent of TCE in soil. Appendix A contains a description of ERM's analytical method and assumptions used to compute the estimated ARCC. The results of the analysis indicates that the preliminary ARCC for TCE in soil vapor at Site 5 is approximately 200 µg/l. This ARCC estimate represents an overall average TCE concentration in the vadose zone at Site 5.

Conclusions

Soil contamination is present at Site 5. Although none of the contaminants presently exceed action levels, it is probable that the contaminants are effecting ground water chemical quality, and they should be removed. The ARCC for TCE has been preliminary estimated to be approximately 200 µg/l for Site 5 soil vapor. This preliminary estimate is based on the overall average TCE concentration in soil vapor within the 88-foot thick vadose zone. The maximum TCE concentration in shallow and deep soil vapor samples collected during the RI were approximately 3,000 and 1,800 µg/l, respectively.

SECTION 2.0

DESCRIPTION OF REMEDIAL ALTERNATIVES

2.1 Remedial Action Objectives

The following sections discuss ARARs and preliminary remediation goals for Site 5 soils.

2.1.1 ARARs

The AANG Base is located within EPA's TIA Superfund site and is therefore included on the National Priorities List (NPL). CERCLA Section 120 states that an installation included on the NPL is subject to all the legal requirements of CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA requires that remedial actions selected are protective of both human health and the environment, and that they comply with ARARs.

Definition of ARARs

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not specifically "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or the circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the site that their application is well suited to evaluate site remedial actions. However, in some circumstances a requirement may be relevant, but not appropriate, for the site-specific situation.

In determining whether a requirement applies to the AANG Base, potential ARARs were initially screened for applicability. If determined not to be applicable, the requirement was then reviewed for both relevance and appropriateness. Requirements that are determined to be relevant and appropriate command the same importance as applicable requirements.

In addition to ARARs, federal, state, and local criteria, advisories, or guidances that also may apply to the conditions found at the AANG Base were reviewed and are referred to as "to-be-considered" (TBC). TBCs are not legally binding, however, they are used within the context of the assessment and control site risks. ARARs, and TBCs necessary for protection, must be attained for hazardous substances, pollutants, and contaminants on-site.

Types of ARARs

ARARs that govern actions at CERCLA sites fall into three categories, based on site characteristics, chemicals present, and remedial alternatives:

- Chemical-specific ARARs are numerical values that represent a health- or risk-based standard or the results of methodologies used to determine acceptable concentration of chemicals that may be found in or discharged to the environment. An example of a chemical-specific ARAR is an maximum contaminant level or air quality standard.

- Location-specific ARARs govern activities in certain environmentally sensitive areas. Examples are floodplains, wetlands, endangered species habitat, or historically significant resources.

- Action-specific ARARs are technology- or activity-based requirements or restrictions. Examples of action-specific ARARs include monitoring requirements, effluent discharge limitation, hazardous waste manifesting requirements, and occupation health and safety requirements.

Applicable ARARs

Chemical-, location-, and action-specific ARARs were reviewed and are presented in the following sections. All of the ARARs in this section are considered as "Draft" status. ANGRC has requested that the Arizona Department of Environmental Quality (ADEQ) prepare a list of ARARs for this FFS. ADEQ representatives, prepared a list of potential ARARs for this Draft FFS (Appendix B). The following

sections include a list of ARARs provided by ADEQ and compiled based on ERM's review.

Chemical-Specific ARARs. ERM reviewed potential federal, state, and local chemical-specific ARARs for soil. Table 2-1 includes a summary of chemical-specific ARARs and TBCs.

Location-Specific ARARs. ERM reviewed potential federal, state, and local location-specific ARARs. Table 2-2 includes a summary of location-specific ARARs and TBCs.

Action-Specific ARARs. ERM reviewed potential federal, state, and local action-specific ARARs. Table 2-3 includes a summary of action-specific ARARs and TBCs.

2.1.2 Cleanup Goals

ERM evaluated cleanup goals for site soils based on results of the preliminary risk assessment and based on the review of chemical-specific ARARs. All of the cleanup goals in this FFS are based on a 10^{-6} risk level.

No cleanup goals have been set for surface soils because concentrations of the VOCs in all surface soils are less than ingestion-based TBCs (ADEQ's HBGLs and EPA's Subpart S action levels). A preliminary cleanup goal was developed for Site 5 soils based on ERM's estimated ARCC. As indicated in a previous section of the FFS, EPA has adopted a policy with regards to soil remediation in the TIA Superfund site that recommends each contaminant be removed from soils until an ARCC is achieved. The estimated ARCC of 200 µg/l has been developed in order to provide a guide to determine the approximate scope and timeframe for the remedial alternatives presented in the following sections of this FFS. In the future, it will be necessary to provide a demonstration that soil cleanup has been achieved at Site 5. As part of this demonstration, it will be necessary to: collect actual depth-specific soil gas data for TCE analysis during operation of the selected remedial alternative; rerun the VLEACH/mixing cell models using these data; and present a documentation that the ARCC has been achieved given actual field conditions.

2.2 Presumptive Remedy Screening Process

A description of Presumptive Remedy screening process and its application to this FFS are discussed below.

TABLE 2-1

Chemical-Specific Applicable or Relevant and Appropriate Requirements for Site 5 Soil

Compounds	HBGLs, Residential (mg/kg)	HBGLs Non-Residential (mg/kg)	EPA Subpart S Action Levels (mg/kg)	Maximum Concentration in Site 5 Soil (mg/kg)
TCE	120	504	60	0.25
PCE	27	113	10	0.025
1,1,1-TCA	11,000	38,500	7,200	0.13
1,1,2-TCA	24	84	120	0.008
1,2-DCA	15	63	8	0.0085

*Human Health-based Guidance Levels for the Ingestion of Contaminants in Soil, Arizona Department of Environmental Quality, June 1995 update.

HBGLs = Human Health-based Guidance Level
mg/kg = milligrams per kilogram.
TCE = Trichloroethylene
PCE = Tetrachloroethylene
1,1,1-TCA = 1,1,1-Trichloroethane
1,1,2-TCA = 1,1,2-Trichloroethane
1,2-DCA = 1,2-Dichloroethane

TABLE 2-2

Location-Specific Applicable or Relevant and Appropriate Requirements for Site 5 Soil

Location	Citation	Requirement Description
Floodplain Areas	40 Code of Federal Regulations (CFR) 264.18 (b)	A Resource Conservation and Recovery Act facility located with a 100-year flood plan must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood.
Area Where Action May Cause Irreparable Harm, Loss, or Destruction of Significant Artifacts	National Archaeological and Historical Preservation Act (16 USC § 469 and 470; 36 CFR Part 65)	Requires action to recover and preserve artifacts if the remedial action threatens significant scientific, prehistoric, historic, or archaeological data. Requires action to preserve historic properties/National Historic Landmarks.
Navigable Airspace	14 CFR 77	Requires notice of construction to be given to Federal Aviation Administration for construction of greater height extending outward and upward at a 100:1 slope for a horizontal distance of 20,000 feet from the nearest runway.
Endangered Species	16 U.S.C. § 1531	Remedial actions shall comply with requirements for endangered species in accordance with the Endangered Species Act.
Fish and Wildlife	1.6 U.S.C. § 661 40 CFR § 6.302	Remedial actions shall protect the fish and wildlife of the area.

TABLE 2-3

Action-Specific Applicable or Relevant and Appropriate Requirements for Site 5 Soil

Action	Citation	Requirement Description
Remedial Actions	49 ARS § 282	Remedial actions must (a) assure the protection of public health and welfare and the environment; (b) to the extent practicable, provide for the control and management of clean-up of the hazardous substance so as to allow the maximum beneficial use of the waters of the state; and (c) be cost effective over the period of potential exposure to such hazardous substance.
Air Emissions	Air Pollution Control Permits (ARS 49-426)	Requires installation and operating permits to be obtained for equipment or devices that may cause or contribute to air pollution. Operating permits may contain conditions that are consistent with the federal Clean Air Act (CAA).
	Pima County Air Quality Control Regulation 17:12.090 Sub-Paragraph E	This ordinance requires a proposal of reasonably available control technology in the event that a stationary source has the potential to emit a total of 2.4 lb/day of volatile organic compounds.
	CAA 42 USCA 7401-7642, 40 Code of Federal Regulations (CFR) 50-99. National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50)	Establishes National Ambient Air Quality Standards for ambient air quality to protect public health and welfare.
	Standards of Performance for New Stationary Sources (40 CFR 60.1-60.18, 60. 50-60.54)	Sets New Source Performance Standards for emissions from new or modified sources. The standards reflect the degree of emission reduction achievable through demonstrated best technology, considering costs and a number of other factors.

TABLE 2-3

Action-Specific Applicable or Relevant and Appropriate Requirements for Site 5 Soil

Action	Citation	Requirement Description
	Air Stripper Emissions EPA OSWER Directive 9355.0-2.8	Controls are needed on most sources with an actual emissions rate of 3 Lb/hr or 15 lb/day or a potential rate of 10 tons per year of total VOCs because VOCs are ozone precursors. The basis of the need for control indicates that this guidance should be considered for SVE emissions as well as air stripper emissions.
Treatment, Storage, and Disposal of Hazardous Wastes	Generators of Hazardous Waste (40 CFR 262)	Requires generators who treat, store, or dispose of hazardous waste to obtain an EPA identification number (40 CFR 262.12); prepare manifests for transportation of hazardous waste for off-site treatment, storage, or disposal (40 CFR 262.20-262.23); comply with pretransport requirements (40 CFR 262.40-262.43); and maintain records and submit reports 40 CFR 262.40-262.43. These requirements would be applicable to alternatives involving either on-site or off-treatment, storage, or disposal. These requirements are triggered when ground water activated carbon is used for remediation of VOCs.
Storage of Hazardous Waste/Contaminated Carbon	Subpart I - Use and Management of Containers (40 CFR 264.170-178) ARS 49-921 et seq and AAC R18-8-260 et seq.	Containers of Resource Conservation and Recovery Act hazardous waste must be maintained in good condition, compatible with hazardous wastes to be stored, and closed during storage except to add or remove waste. Container areas should be inspected weekly for deterioration. Secondary containment system is required for storage of hazardous waste over 90 days.
Transportation of Hazardous Waste	40 CFR 263	Transportation must be in a licensed hazardous waster hauler. In the event of a discharge during transportation, the transporter must take immediate action to protect human health and the environment (40 CFR 263.30) and clean up the discharge such that it no longer presents a hazard (40 CFR 263.31). Residual waste being transported to an off-site disposal facility would be subject to this requirement.

TABLE 2-3

Action-Specific Applicable or Relevant and Appropriate Requirements for Site 5 Soil

Action	Citation	Requirement Description
Worker Health and Safety	Occupational Safety and Health Act (OSHA) 29 USC 651-678, 19 CFR 1910	OSHA requirements under 19 CFR 1910-120 are applicable to worker exposures during response actions at Comprehensive Environmental Response, Compensation, and Liability Act sites, except in states that enforce equivalent or more stringent requirements.

2.2.1 Description

EPA has studied various technologies applied at CERCLA sites with VOC contamination in soils as part of its effort to streamline the FS process. This evaluation consisted of an analysis of the technical literature and review of the results of the remedy selection process from FSs and Records of Decisions (RODs). The purpose of the evaluation was to formulate general conclusions about the application of these technologies at sites with VOC contamination in soils. The evaluation is summarized in EPA's report entitled *Feasibility Study Analysis For CERCLA Sites with Volatile Organic Compounds in Soils* (August 1994). The evaluation concluded that certain technologies were routinely screened out during the FS process based on lack of effectiveness, difficulty to implement, or excessive costs. The evaluation also concluded that three remedies (SVE, thermal desorption, and incineration) were frequently selected to address VOC contamination in soils at CERCLA sites. Based on its evaluation, the EPA determined that several treatment technologies could be eliminated from consideration during the FS process at sites where the Presumptive Remedy of SVE, thermal desorption, or incineration would be appropriate. Furthermore, the agency recommended that its August 1994 report could be used as a reference in an FS when the technology identification and screening steps are abbreviated or eliminated when adopting the Presumptive Remedy approach.

2.2.2 Site-Specific Application

In adopting the Presumptive Remedy approach it was necessary to determine how the approach would be applied to Site 5 soils. EPA has prepared additional guidance to further streamline the technology evaluation under the Presumptive Remedy approach. The directive is entitled *Presumptive Remedies: Site Characterization and Technology Selection for CERCLA sites with Volatile Organic Compounds in Soils* (Directive 9355.0-48FS, September 1993). This directive contains a decision tree that describes the sequence of steps involved in evaluating the three Presumptive Remedy technologies.

EPA has found that SVE has been selected most frequently to address VOC contamination at Superfund sites. Additionally, SVE performance data indicates that technology effectively treats contaminated soils in place at relatively low costs. Therefore, EPA considers SVE to be the primary Presumptive Remedy at all VOC-contaminated sites. EPA recommends that thermal desorption be evaluated for sites where SVE will not work effectively or where highly concentrated contamination is present. At the limited number

of sites where neither SVE nor thermal desorption would be effective, EPA recommends consideration of incineration.

ERM performed a two-stage review to determine if EPA primary Presumptive Remedy, SVE, would be applicable to the site. The review was comprised of the following:

- Review of case studies for various Superfund sites, both in Arizona and other locations throughout the country.
- Review of site-specific data for Site 5, including nature and extent of contamination, and geologic and hydrogeologic conditions as applicable to SVE performance.

Case Studies

Various case studies have shown SVE remediation to be successful in removing VOC contamination from the vadose zone. In Goodyear, Arizona, VOC contamination was detected in soils at an airport built in the 1940s. An SVE system was recently installed and is continuing to operate. Within 4 months, 393 pounds of VOCs were removed from the site. In Belleview, Florida, an underground storage tank had leaked. An SVE system was used to treat the soil, and in 9 months there was a 98.66 percent reduction in contamination, with 30,000 pounds of VOCs removed from the site. At Kelly AFB in Texas, JP-4 jet fuel had leaked from an underground pipeline. A pilot study was performed over 23 days using an SVE system, and 6,578 pounds of VOCs were removed.

Recently at the Air Force Plant (AFP) 44 in Tucson, Arizona, a Feasibility Study Report was produced (Earth Tech, 1994) that considered a number of remediation technologies such as: SVE, Soil Flushing, Bioventing, Steam Extraction, Thermal Desorption, and Incineration. The AFP 44 was split into a number of sites with their Site 1 having the closest geological similarity to AANG Base Site 5. The preferred remedial alternative for AFP 44 Site 1 was SVE. An SVE pilot test was conduced and 595 pounds of VOCs were removed from Site 1 during the 28-day test.

Review of Site-Specific Data.

ERM reviewed site-specific data for Site 5 against EPA's list of key site features and contaminant properties that, if present, suggest that the SVE alternative could be successfully utilized as a cleanup remedy. Details regarding the review is included in Table 2-4. The results of the review of site-specific data suggest that the types of contaminants

TABLE 2-4

Screening Applicability of SVE Technology to Site 5 Soils

CHARACTERISTIC	SOIL VAPOR EXTRACTION SCREENING CRITERIA EPA (1993b)	AANG BASE SITE 5 SUPPORTING DATA	REFERENCE
Site Geology, USGS Soil Classification and Porosity	SVE is most effective in permeable, homogeneous soil with porosity greater than 40 percent.	The Site 5 unsaturated zone lies between the ground surface and the upper ground water subunit and is composed predominantly silty sands, sands with scattered gravel, and sandy silts. The effective porosity is approximately 40 percent at a depth of 70 feet below grade.	ORNL/ETS RI, page J-17 Refer to Figure 1-6 in this FFS report.
Soil Air Permeability	For SVE to be effective, the soil/air permeability should be greater than 10^{-6} cm^2. SVE is potentially effective in less permeable soil— i.e., between 10^{-6} to 10^{-10} cm^2, but should be confirmed by pilot testing.	Site 5 soil is porous and permeable to allow sufficient vapor transport for SVE under vacuum conditions. The overall soil/air permeability is assumed to be 5 darcys or 5×10^{-8} cm^2 for well-sorted sands.	ORNL/ETS RI, page 2-54
Soil Moisture, Depth to Ground Water	High moisture content in soil may drastically decrease its air permeability and thus, the effectiveness of SVE. SVE is not effective for soil media with greater than 50 percent saturation and/or soils with shallow ground water table.	Typically, the soils exhibit a low moisture content. Liquid-phase water movement is restricted to the near-surface regions, while vapor-phase transport controls the movement of water in the bulk of the vadose zone. Only soil above the water table will be influenced by the SVE system. Ground water level varies seasonally but is typically found at a depth greater than 80 feet below ground level.	ORNL/ETS RI, page 2-62
Soil Temperature	Contaminant vapor pressure, dimensionless Henry's Law constant, water solubility, and phase density are strong functions of temperature.	Arid desert conditions of the AANG Base promotes the applicability of SVE.	No actual soil temperature data was provided in the RI.

cm^2 = square centimeters
°C = degrees centigrade
°F = degrees Fahrenheit

TABLE 2-4

Screening Applicability of SVE Technology to Site 5 Soils

CHARACTERISTIC	SOIL VAPOR EXTRACTION SCREENING CRITERIA EPA (1993)	AANG BASE SITE 5 SUPPORTING DATA	REFERENCE
Contaminant Identity and Properties	Vapor Pressure - SVE is effective for compounds with a vapor pressure greater than 0.5 mm Hg. Dimensionless Henry's Constant (H) - SVE is effective for compounds with constants greater than 0.01.	The principal contaminants of concern at Site 5 meet the screening criteria for SVE. Trichloroethylene (TCE): Vapor pressure is 75 mm Hg at 25°C, H=0.363. Tetrachloroethylene (PCE): Vapor pressure is 19 mm Hg, H= 0.923. 1,1,1-Trichloroethane (1,1,1-TCA): Vapor pressure 123 mmHg, H= 0.166.	Lyman, et. al, 1982 Devitt, et. al., 1987
Contaminant Concentration, Location, Volume, and Depth	Uncertainties regarding distribution of VOCs in soil matrix can impact effectiveness of the SVE design.	The distribution or extent of soil VOC vapor contamination at Site 5 has been fully characterized through the use of both soil matrix and soil gas sampling.	Refer to Figures 1-4 to 1-7 in this FFS report.
Presence of Subsurface Pipes/Material	The presence of water or electrical conduits, soil fracture lines, debris, or any other objects that are more permeable than the surrounding soil will be the preferred pathway to the advecting gases.	While there are both subsurface conduits and soil altered by construction at Site 5, their close proximity to the surface would have insignificant impact on SVE treatment zones starting 20 feet below ground level.	ORNL/ETS RI, pages 7-4 7-1 through 7-3
Soil Humic Content and Contaminant Soil Sorption Coefficient (K_d)	Solvents adhere strongly to soil with high humic content which decreases the effectiveness of SVE. Solvents with a high soil sorption coefficient tent to sorb onto soil or organic matter in the soil.	Soil humic content for coarse-grained sands at depth at Site 5 is assumed to be low. Published log K_{OC} for TCE values range from 2.29 to 2.42 .	No actual data ORNL/ETS RI, Appendix N
Contaminant Adsorption Characteristics on Activated Carbon	This parameter is related to the feasibility of removing contaminants from soil vapor by carbon adsorption. This parameter is important since some compounds, such as methyl ethyl ketone, become unstable as they are adsorbed onto carbon.	Assuming a 200 scfm soil vapor stream with 400 ppm_V TCE, 15 ppm_V PCE, and 5 ppm_V TCA, adsorption isotherm modeling suggested carbon material usage daily rates of 140 lbs initially and 60 lbs steady-state. All three compounds are readily adsorbable onto carbon	Material usage modeling provided by Wheelabrator Clean Air Systems, Inc.

cm^2 = square centimeters
°C = degrees centigrade
°F = degrees Fahrenheit

present, distribution of contaminants, and soil physical parameters at Site 5 are amenable to remediation using SVE.

2.2.3 Results of Screening Analysis

The results of the review of case studies indicates that SVE has been utilized at similar sites throughout the country. Additionally, the SVE alternative has been successfully tested at AFP 44 and has been chosen as a remedy for soils at that site. Soil characteristics and contaminant types at AFP 44 are very similar to those at AANG Base's Site 5. The results of the technology screening analysis suggest that the types of contaminants present, distribution of contaminants, and soil physical parameters are amenable to remediation using SVE. In accordance with EPA Directive 9355.0-48FS, only SVE will be further evaluated as part of this FFS. The no action alternative is also evaluated for comparison purposes.

2.3 Remedial Alternatives

The following sections provide a description of the no action alternative and information regarding three different SVE treatment process options for the for the Site 5 soils at the AANG Base.

2.3.1 No Action (Alternative 1)

Description

Alternative 1 is the No Action Alternative. For this alternative, absolutely no actions would be performed to control site-related risks. The only remediation that would occur is from natural biodegradation and movement of the compounds from soil into ground water. The byproducts of the biodegradation process, such as vinyl chloride, can pose a threat to the environment. This alternative is used as a baseline to compare other alternatives. For comparative purposes, the remediation time for this alternative has been set at 100 years.

Monitoring Requirements

Soil vapor TCE concentrations and upper subunit ground water TCE concentrations would be monitored from existing monitoring well MW05-U and existing vapor wells VW04, VW07, and VW08.

2.3.2 Soil Vapor Extraction (SVE Alternative 2)

Description

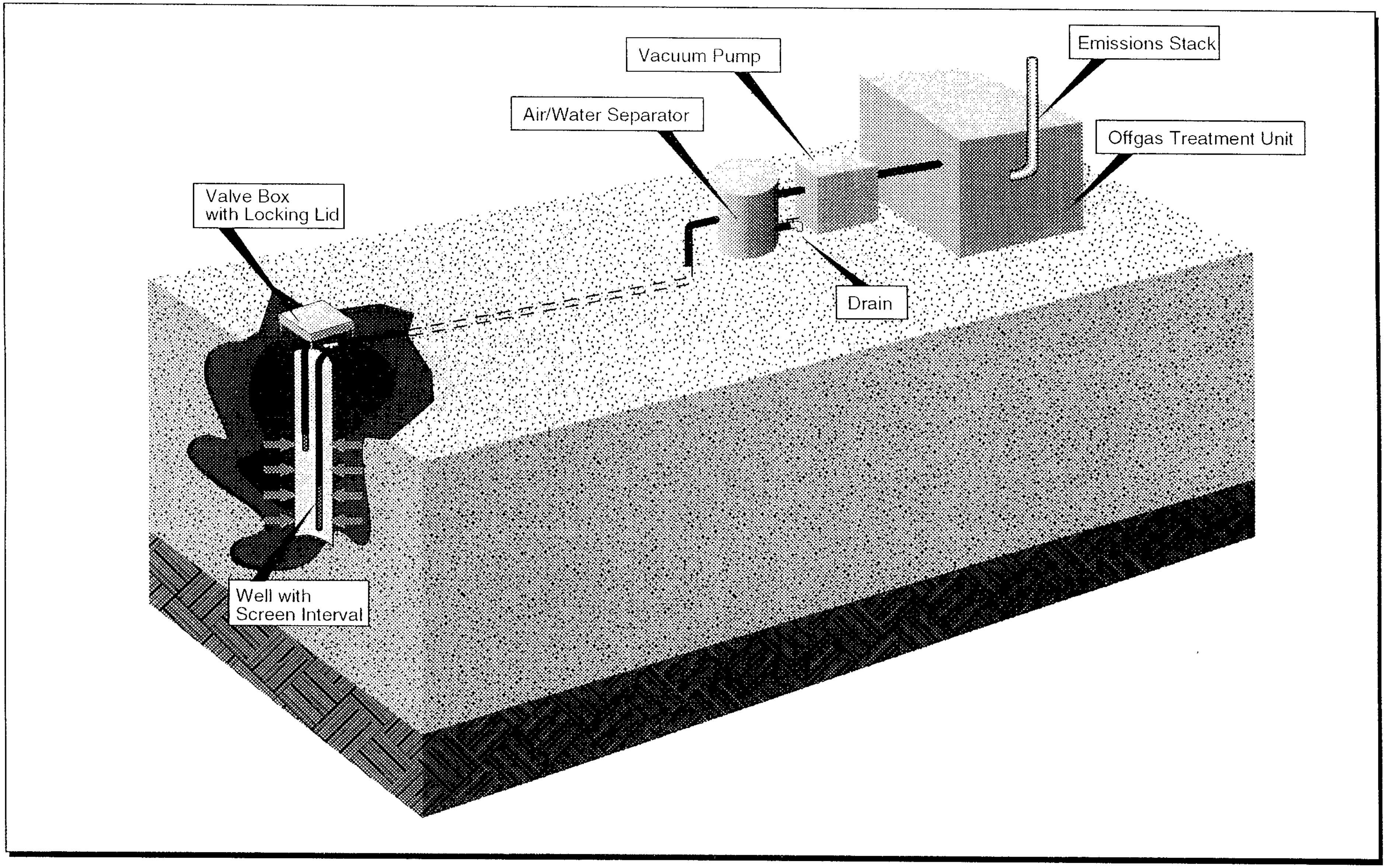
In situ SVE was identified in the technology screening as the most effective method for remediating VOCs in soil. SVE is a means of physically removing VOCs from soil. This is accomplished by inducing air flow throughout the VOC-contaminated soils and collecting the soil vapors through an extraction well for above ground abatement. A typical SVE system (Figure 2-1) consists of one or more extraction wells placed in the effected zone and connected by manifold to a vacuum pump. The pump provides a constant vacuum to the wells which induces the sub-surface air flow. VOCs are transferred from the soil matrix into the air through an evaporative process. VOC laden air is drawn from the wells, through an air/water separator, and into the vacuum pump. Upon exiting the vacuum pump, the air stream can be: discharged through a catalytic oxidizer (CATOX), sent through activated carbon beds, or discharged directly to the atmosphere. These alternatives are discussed briefly below.

Process Options

SVE with Catalytic Oxidation (Alternative 2A). Alternative 2A is SVE with the VOC laden air stream treated utilizing a CATOX. The air stream enters the CATOX and is heated by a natural gas burner. The heated air flows over a platinum based catalyst which oxidizes the VOCs into carbon dioxide, water, and in the case of chlorinated VOCs, hydrochloric acid. A scrubber can be used to remove the hydrochloric acid from the air stream if required. The air stream is then discharged to the atmosphere through a stack.

SVE with Activated Carbon (Alternative 2B). Alternative 2B consists of SVE with the effluent vapor being directed through vessels of activated carbon. Carbon removes VOCs from the air stream by an adsorption process. Molecular adsorption of chemicals occurs through physical and/or chemical forces in which molecules of VOCs are bound to the surface of the carbon particle. The activated carbon particles eventually become saturated and their ability to remove VOCs from the air stream is reduced. As this occurs the spent carbon material will be transported off site for regeneration or disposal.

SVE with No Off Gas Treatment (Alternative 2C). Alternative 2C consists of SVE with no treatment of the effluent vapor. Discharge from the vacuum pump would be connected directly to a stack for discharge to the atmosphere. If the concentration of VOCs in the air stream is low then this may be a viable alternative.



Legend

Sub-surface Air Flow

ERM-West, Inc. 12'94
6004.21/GCF/12.04.94

Figure 2-1
Typical Soil Vapor Extraction System

Monitoring Requirements

Each soil vapor wellhead will contain a sample port for the collection of gas samples to be analyzed off site. Gas sample ports will also be placed throughout the system to monitor the process air stream at various stages. The air/water separator will contain a sight gage to monitor the amount of water collected. Flow, temperature, and pressure of the process stream will also be measured.

A network of vadose zone monitoring wells will be used to evaluate the SVE system performance. These wells would be used to estimate the zone through which airflow is occurring. Additionally, they could also be utilized to draw soil gas samples that will indicate, through mathematical correlation, the rate at which soil cleanup is occurring.

SECTION 3.0

DETAILED ANALYSIS OF ALTERNATIVES

3.1 Introduction

NCP sets forth nine criteria to be used for a detailed, comparative analysis of the remedial alternatives retained after the alternative screening portion of the feasibility study. The following subsections describe the criteria and provide analysis of the selected remedial alternatives against the nine criteria.

3.2 Assessment Criteria

The following sections describe the elements of the nine criteria used for detailed analysis of remedial alternatives.

3.2.1 Overall Protection of Human Health and Environment

The evaluation of the overall protection of human health and the environment for each alternative is based on a composite of factors assessed under other evaluation criteria. The criteria specifically considered are long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. For each alternative, the evaluation should include:

- How the source of contamination is to be eliminated, reduced, or controlled; and
- How site risks are to be reduced and if remedial goals can be attained.

3.2.2 Compliance with ARARs

Each alternative is evaluated for its compliance with ARARs. The analysis summarizes the ARARs applicable to an alternative.

3.2.3 Long-Term Effectiveness and Permanence

The evaluation of a remedial alternative relative to its long-term effectiveness and permanence is made considering the risks remaining at the site after the remedial goals have been met. The assessment of long-term effectiveness is made considering the following four major factors:

- Magnitude of residual risk to human and environmental receptors remaining from untreated waste or treatment residues at the completion of remedial activities.
- Assessment of the type, degree, and adequacy of long-term management required for untreated waste or treatment residues remaining at the site.
- Assessment of the long-term reliability of engineering and/or institutional controls to provide continued protection from untreated waste or treatment residues.
- Potential need for replacement of the remedy and the continuing need for repairs to maintain the performance of the remedy.

3.2.4 Reduction of Toxicity, Mobility, or Volume (TMV) Through Treatment

This evaluation criterion addresses the degree to which remedial actions employ treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume (TMV) of the hazardous substances. The evaluation considers the following factors:

- Treatment processes;
- Amount of hazardous materials that will be treated;
- Degree of expected reduction in TMV, including how the principal threat is addressed through treatment;
- Degree to which the treatment will be irreversible; and
- Type and quantity of treatment residuals that will remain following treatment.

3.2.5 Short-Term Effectiveness

The short-term effectiveness of a remedial alternative is evaluated relative to its effect on human health and the environment during

implementation of the remedial action. The short-term effectiveness is assessed based on the following factors:

- Short-term risks that might be posed to the community during implementation of an alternative;
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures;
- Potential environmental impacts of the remedial action, and the effectiveness and reliability of mitigative measures during implementation; and
- Time until remedial action objectives are achieved.

3.2.6 Implementability

The remedial alternatives must be evaluated to estimate the degree to which each can satisfy implementability criteria. Implementability refers to the technical, administrative, and environmental feasibility of implementing an alternative, and the availability of various materials and services required during its implementation.

3.2.7 Cost

A detailed cost estimate is developed for each remedial alternative in accordance with procedures in the Remedial Action Costing Procedures Manual (EPA, 1985). Cost estimates for each alternative are based on conceptual design and are expressed in terms of 1994 dollars. The cost estimates are prepared with plus 50 percent to minus 30 percent accuracy. The detailed cost estimates are presented in Appendix C.

3.2.8 State Acceptance

This criterion evaluates the technical and administrative issues and concerns the ADEQ may have regarding each of the alternatives.

3.2.9 Community Acceptance

This criterion evaluates the technical and administrative issues and concerns the public may have regarding each of the alternatives.

3.3 Individual Evaluation of Alternatives

The following presents an evaluation of the remedial action alternatives against the evaluation criterion. ERM did not perform evaluation against two criteria (State Acceptance and Community Acceptance) in this Draft FFS. These criteria are typically addressed following receipt of comments during review of the Draft Final FFS or during the ROD process.

3.3.1 Alternative 1 - No Action

A description and assessment of Alternative 1 is discussed below.

Description

Alternative 1 is the No Action remedial alternative. No action would be performed to control site-related risks. The only remediation that would occur is from natural biodegradation and movement of the compounds from soil into ground water.

Assessment

Overall Protection of Human Health and Environment. The No Action Alternative would be protective of human health and the environment in the short-term because no significant exposure to soil or soil gas contamination is expected at land surface. Because the soil vapor would be left in place, vertical movement through the vadose zone would result in a long-term adverse impact to chemical quality of upper subunit ground water.

Compliance with ARARs. The No Action Alternative meets chemical-specific ARARs because no ARAR has been promulgated for soil vapor concentrations. Current maximum total concentrations of VOCs detected in soil samples collected during ORNL/ETS's RI are less than HBGLs. No action or location-specific ARARs apply to this alternative.

Long-Term Effectiveness and Permanence. The No Action Alternative would be expected to be effective in the long-term once vertical migration of vapor phase TCE concentrations are reduced to below the 200 μg/l remedial goal due to vapor transport to ground water. Long-term monitoring of soil vapor concentrations would be required to observe concentration reductions and to verify attainment of the remedial goal.

Reduction of TMV Through Treatment. The No Action Alternative does not include any treatment to reduce TMV. As a result, it is expected that TCE would continue to leach through the vadose zone to the underlying upper subunit ground water. Biodegradation of TCE by soil microorganisms is not expected to be significant, however, this process may serve to reduce TCE concentrations in soil vapor.

Short-Term Effectiveness. The No Action Alternative would not present appreciable short-term direct contact or inhalation human health risks. However, under this alternative the bulk of the contaminant mass may migrate out of the vadose zone over a very long period of time. This contaminant mass would, therefore, continue to threaten upper subunit ground water chemical quality.

Implementability. The No Action Alternative would not have implementation obstacles. In addition, there are no operations and maintenance requirements for the alternative.

Cost. No costs would be associated with implementing the No Action Alternative.

3.3.2 Alternative 2 - Soil Vapor Extraction

A description and assessment of Alternative 2 is discussed below.

Description

Three alternatives for SVE were developed in Section 2 of this FFS. The alternatives are:

- SVE with Catalytic Oxidation (Alternative 2A);
- SVE with Activated Carbon (Alternative 2B); and
- SVE with No Off gas Treatment (Alternative 2C).

Assessment

Overall Protection of Human Health and Environment. All three SVE alternatives will be equally effective in removing TCE concentrations and therefore, removing the source of this compound to upper subunit ground water. The estimated time to achieve preliminary remedial goals is identical in each case because all three alternatives share the same SVE system.

Operations associated with SVE with No Off gas Treatment (Alternative 2C) would afford the least overall protection of human

health and the environment, due to two factors: potential non-compliance with air emission standards; and potential risks associated with transfer of TCE from soil gas to the atmosphere.

Operations associated with SVE with Activated Carbon (Alternative 2B) produces spent carbon that must be regenerated or disposed of. The reduction in volume and toxicity of TCE depends greatly on the method used for final disposition of the spent carbon.

Operations associated with SVE with Catalytic Oxidation (Alternative 2A) would result in a minor (5 percent or 2.0 pounds of VOCs per day) discharge of total TCE removed from the soil to the atmosphere. This discharge is estimated based on the expected efficiency of the treatment system.

Compliance with ARARs. All three SVE alternatives are expected to satisfy chemical-specific and location-specific ARARs. Case studies of SVE operations have shown that these systems typically produce much higher VOC emissions during the initial months of operations than is produced in later years. ERM has performed computations that suggest that the initial mass removal rate will be approximately 40 pounds of VOCs per day. ERM calculations assumed an initial soil vapor extraction flow rate of less than 200 cubic feet per minute. SVE with No Off gas Treatment (Alternative 2C) may not meet Pima County's air VOC emission limit of 2.4 pounds per day during the initial stages of SVE operations. ERM estimates that Catalytic Oxidation (Alternative 2A) may result in VOC emissions of approximately 2 pounds per day, based on a 95 percent destruction removal efficiency (DRE). However, SVE with Activated Carbon (Alternative 2B) will comply with Pima County air emission standards.

Long-Term Effectiveness and Permanence. All three SVE alternatives would be expected to provide equal effectiveness once the residual TCE soil vapor concentration in Site 5 soils decreased below the cleanup goal. Soil vapor monitoring would be required for a period of years after the SVE system is deactivated in order to verify attainment of the cleanup goal.

Reduction of TMV Through Treatment. SVE with Catalytic Oxidation (Alternative 2A) would reduce the toxicity, mobility, and volume of TCE based on the projected 95 percent DRE for this compound. The remaining 5 percent would be discharged from a tall stack into the atmosphere. The byproducts of treatment would be carbon dioxide, water, and hydrochloric acid vapor. The acid vapor would be neutralized with soda ash (sodium bicarbonate) prior to discharge into the atmosphere.

SVE with Activated Carbon (Alternative 2B) would reduce the mobility of TCE by sorbing the compound onto activated carbon. The volume and toxicity of TCE may also be reduced, depending on the final disposition of the spent carbon (e.g., incineration).

SVE with No Off gas Treatment (Alternative 2C) would result in transfer of the mass of TCE removed from the ground directly to the air. The alternative depends on dilution in the air mass to reduce toxicity. No volume or mobility reduction is expected during implementation of this alternative.

Short-Term Effectiveness. It is difficult to estimate with accuracy the time required to meet the remediation goal. Using simplifying assumptions regarding extraction rates, SVE alternatives would be expected to reduce soil vapor TCE concentrations to less than the 200 μg/l cleanup goal within 5 years.

Implementation of all the SVE alternatives would entail construction-related risks during drilling of vapor extraction wells. Additionally, some additional risks may be posed due to the requirement of handling sodium bicarbonate on site for neutralization of hydrochloric acid formed during implementation of SVE with Catalytic Oxidation (Alternative 2A). However, with appropriate and readily available monitoring and protective equipment, risks associated with installation and operation of each of the SVE alternatives would be approximately the same.

Implementability. SVE is a proven technology that has been effective in remediating soils at similar sites, including soils at the AFP 44 site, located near the AANG Base. SVE extraction wells are commonly installed by contractors in Arizona and throughout the southwest United States. Some of the optimal locations for SVE extraction wells may not be easily accessible due to the presence of Building 33. However, it is anticipated that adequately effective alternate locations could be found for the wells. All three SVE process options are commonly utilized to remove VOCs from soils at contaminated sites. Equipment and materials associated with construction of treatment systems is readily available for all three SVE remedial alternatives.

Of the three SVE alternatives, SVE with Activated Carbon (Alternative 2B) will produce a waste product (spent carbon) that will require off-site treatment, regeneration, or disposal. Options for ultimate disposition of the spent carbon could potentially become increasingly limited over the lifetime of the remedial action should state or federal regulations change in the future. Currently, the closest carbon regenerating and disposal facilities available to accept spent carbon are located in Parker,

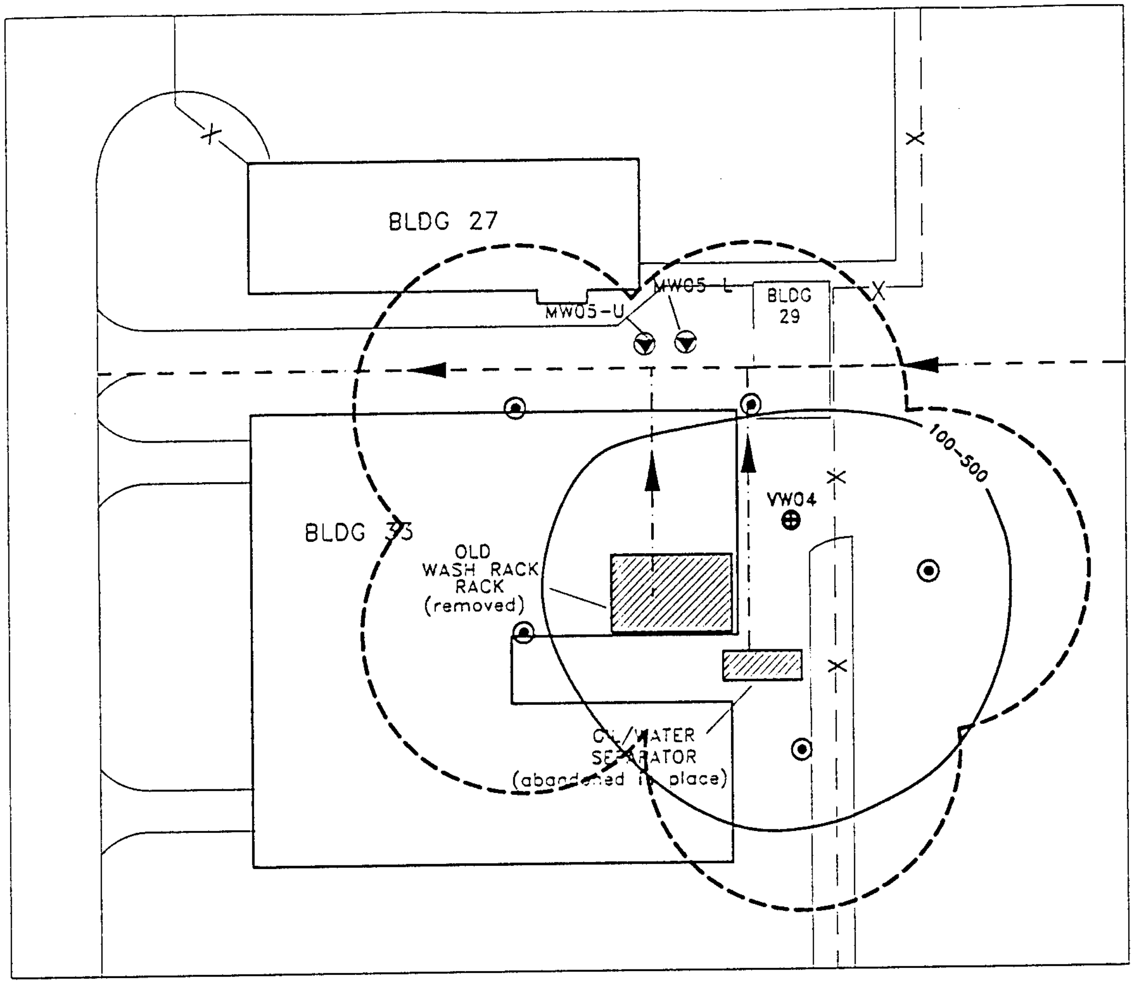
Arizona. This facility started operations in 1992 and has a present capacity of 3.5 million pounds per year, and is projected to increase its capacity to 12 million pounds per year. Thus, equipment and personnel should be readily accessible for the three SVE alternatives during the lifetime of the project.

<u>Cost.</u> Cost estimates for the three SVE alternatives are provided in Appendix C. These cost estimates are order-of-magnitude level estimates. In accordance with EPA guidance, the cost estimates have an expected accuracy of approximately plus 50 to minus 30 percent.

The cost estimates have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on the actual labor and material costs, actual site condition, productivity, competitive market conditions, final project scope and design, final project schedule, and other variable factors. As a results, the final project costs may vary from those presented in this FFS.

Soil vapor concentration data collected from vapor monitoring well MW04 were used as the basis for preliminary equipment sizing and for subsequent cost computations. The estimated total mass of TCE in the vadose zone at Site 5 is 37 kilograms (or 82 pounds). The estimated total mass of VOCs in the vadose zone at Site 5 is 42 kilograms (or 92 pounds).

For the silty and gravelly sands at Site 5, ERM assumed a pneumatic permeability of five darcys and a corresponding yield of 3-1/3 standard cubic feet per minute per linear foot of well screen. ERM has proposed a vapor extraction wellfield comprised of a total of eight extraction well clusters. Existing vapor monitoring well clusters VW04, VW07, and VW08 can be used as observation wells. These existing wells are indicated as "In-Service Vapor Wells" on Figure 3-1. Five proposed new vapor extraction well clusters would be installed at locations surrounding Building 33. Each new extraction well cluster would be comprised of 2-inch diameter wells screened over a 60 foot interval. The projected total vapor flowrate for the wellfield is 200 cubic feet per minute. ERM calculated that each active SVE well cluster could influence a radial distance of about 50 feet. The estimated radius of



SITE 5
162nd FIGHTER GROUP
ARIZONA AIR NATIONAL GUARD

LEGEND

100-500 TCE IN SHALLOW SOIL VAPOR (ug/L)

ESTIMATED RADIUS OF INFLUENCE (50 ft radius)

PROPOSED VAPOR EXTRACTION WELL LOCATION

GROUNDWATER MONITORING WELL LOCATION

IN-SERVICE VAPOR WELL LOCATION

SANITARY SEWER

N.

0 30 60 120 180

SCALE IN FEET

ERM

FIGURE 3-1 PROPOSED SVE WELLFIELD AND REMEDIATION AREA			
Compiled by ERM from AANG RI Report, Draft Final - October 1994			
DATE 1-04-95	SCALE 1"= 60'	DRAWING NUMBER A-6003.21-08	JOB NUMBER 6003.21
SIZE A	SHEET 1 of 1	REV 0	ERM CAD ID NUMBER F:\HOME\SHARON\TUCSON\60032108
ENVIRONMENTAL RESOURCES MANAGEMENT - WEST			

influence for the entire extraction wellfield system is shown on Figure 3-1.

The costs for the three SVE alternatives and assumptions used in cost calculations are presented in Appendix B. In summary, the cost estimates for the three alternatives are as follows:

- SVE with Catalytic Oxidation (Alternative 2A) $1,087,000
- SVE with Activated Carbon (Alternative 2B) $1,047,000
- SVE with No Off gas Treatment (Alternative 2C) $648,000

3.4 Comparative Analysis

The following section provides a comparison of the Site 5 soil remedial alternatives to one another. It is currently anticipated that the soil at Site 5 will be remediated using SVE methods within a 5-year time period.

Protection of Human Health and the Environment. The No Action Alternative (Alternative 1) provides no reduction of risk of continued transport of TCE to upper subunit ground water. All three SVE alternatives will reduce and ultimately eliminate the risk to ground water. Implementation of SVE with No Off gas Treatment (Alternative 2C) includes potential continuing risks associated with transfer of TCE from soil gas to the atmosphere. Implementation of SVE with Catalytic Oxidation (Alternative 2A) includes a minor risk associated with potential elevated emissions of TCE to the atmosphere during the initial startup of remedial actions. SVE with Activated Carbon (Alternative 2B) presents the least risk to local receptors of the three SVE alternatives. However, implementation of this alternative involves some risk to off-site receptors due to off-site transport and disposal/regeneration of spent carbon that will be required to operate the system.

Compliance with ARARs. All of the alternatives evaluated will comply with chemical-specific and location-specific ARARs. Pima County air VOC emission limit, an action-specific ARAR will likely not be met with if SVE with No Off gas Treatment (Alternative 2C) is implemented. It appears that SVE with Catalytic Oxidation (Alternative 2A) and SVE with Activated Carbon (Alternative 2B) will comply with Pima County's air emission standards.

Long-Term Effectiveness and Permanence. The No Action Alternative would be expected to be effective in the long-term only after the bulk of contaminants have been transported to ground water. All of the SVE remedial alternatives are expected to be equally effective in the long-term.

Reduction of TMV through Treatment. No reduction of TMV would be expected during implementation of the No Action Alternative. Of the SVE alternatives, SVE with No Off gas Treatment (Alternative 2C) provides the least reduction of TMV. SVE with Catalytic Oxidation (Alternative 2A) and SVE with Activated Carbon (Alternative 2C) may are approximately equal in reduction of TMV, depending primarily on the method of spent carbon disposal.

Short-Term Effectiveness. The No Action Alternative would not present appreciable short-term direct contact or inhalation human health risks. However, the mass of contaminants in Site 5 soils would continue to threaten upper subunit ground water chemical quality.

Using simplifying assumptions regarding soil vapor extraction rates, ERM estimates that all of the SVE alternatives (Alternatives 2A through 2C) would be expected to reduce soil vapor TCE concentrations to less than the 200 µg/l cleanup goal within approximately 5 years. The cleanup goal may not be achieved for decades if the No Action Alternative (Alternative 1) is implemented.

Implementability. All of the alternatives are technically feasible and implementable using existing technologies.

Cost and Uncertainties. Cost estimates provided in Appendix B show that implementing the SVE using the vapor treatment method (catalytic oxidation or carbon adsorption) would result in a net present value of $1.1 million dollars over the course of 5 years. Activated carbon treatment may be less costly than catalytic oxidation if: 1) the platinum-based catalyst in the CATOX unit requires more frequent replacement; or 2) the TCE concentration in soil vapor is less than estimated. Conversely, catalytic oxidation treatment may be less costly than activated carbon treatment if VOC concentrations in extracted soil vapor during initial startup is significantly greater than the concentrations previously detected at Site 5. Should significantly high VOC concentrations exist in the soil vapors, then carbon consumption may exceed the quarterly material change-out estimate and would cause frequent system shutdowns. Additionally, should the time required to achieve the cleanup goal exceed the estimated 5 years, then costs for all of the SVE alternatives would increase.

3.5 Preferred Alternative

SVE with Activated Carbon (Alternative 2B) should be implemented at Site 5. A pilot SVE test will be performed to determine actual in situ soil permeabilities at Site 5 and to provide a basis for a refined SVE design to be prepared during the Remedial Design process.

SECTION 4

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APPENDIX A

NUMERICAL AND ANALYTICAL VADOSE ZONE MODELING

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APPENDIX A

VADOSE ZONE MODELING

The following appendix presents information regarding vadose zone modeling performed in support of the Remedial Investigation and this Feasibility Study. The first sections contain excerpts from Oak Ridge National Laboratory/Environmental Technology Section's (ORNL/ETS's) report entitled*Final Remedial Investigation Report, 162nd Fighter Group, Arizona Air National Guard, Tucson, Arizona* (June 1995). ERM-West, Inc., performed minor editing of the original ORNL/ETS text to allow the section to be presented as a stand-alone appendix. This appendix also includes a summary of ERM's additional vadose zone modeling performed in support of selection of a cleanup goal for Site 5 soils.

Oak Ridge National Laboratory Modeling

Introduction

The shallow soil vapor and vapor monitoring well data collected during the remedial investigation (RI) suggested the presence of a potentially significant source of volatile organic compounds (VOCs) in soils in the Site 5 area. The evaluation of the transport of VOCs through unsaturated soils and quantification of the amount of VOCs entering the water table is a complex problem, particularly at the Arizona Air National Guard (AANG) Base, where vapor movement is the dominant transport mechanism. Previous attempts at quantifying the amount of VOCs entering the ground water at other arid sites focused on infiltration or liquid transport, diffusive transport, or density-driven transport. All of these approaches are limited by the variability of the physical parameters that control transport in the unsaturated zone.

To avoid these limitations, ORNL/ETS adopted two new approaches during the RI investigation to help quantify the amount of trichloroethylene (TCE) entering the water table. The first an analytical solution, and the second, a numerical solution, are both based on the same conceptualization of contamination described below.

Conceptual Model

ORNL/ETS formulated the following conceptual model of soil contamination. The conceptual model included the following elements:

- The source of ground water contamination was conceptualized as a set of three concentric rings of TCE contamination (Figure A-1). TCE vapor concentrations in each ring are average values based on vapor samples as measured near the water-table surface in VW04, VW07, and VW08.

- Partition coefficients were applied to the average TCE vapor concentrations to estimate TCE concentrations in water at the water-table surface according to Henry's Law constant, 0.365. As shown in Figure A-1, the outer ring of diameter 400 feet is at a ground water concentration of 450 micrograms per liter (μg/l), which corresponds to a vapor concentration of 166 μg/l. The intermediate ring of diameter 90 feet is at a ground water concentration of 1,120 μg/l, which corresponds to a vapor concentration of 416 μg/l. The innermost ring of diameter 50 feet is at a ground water concentration of 2,250 μg/l, which corresponds to a vapor concentration of 833 μg/l.

- Transport into the aquifer is by diffusion and transfer of mass by diffusive transport is dependent on the size of the source area and the ground water velocity.

- Water samples from the downgradient monitoring well MW05-U are representative of the entire saturated thickness of the upper subunit (12 feet).

Analytical Solution

An analytical method was developed to estimate the amount of mass transfer from the water-table surface into the aquifer. Using a one-dimensional diffusion equation presented by Freeze and Cherry (1979), the average concentration of VOC was calculated by integrating over the aquifer thickness, which yielded the equation below.

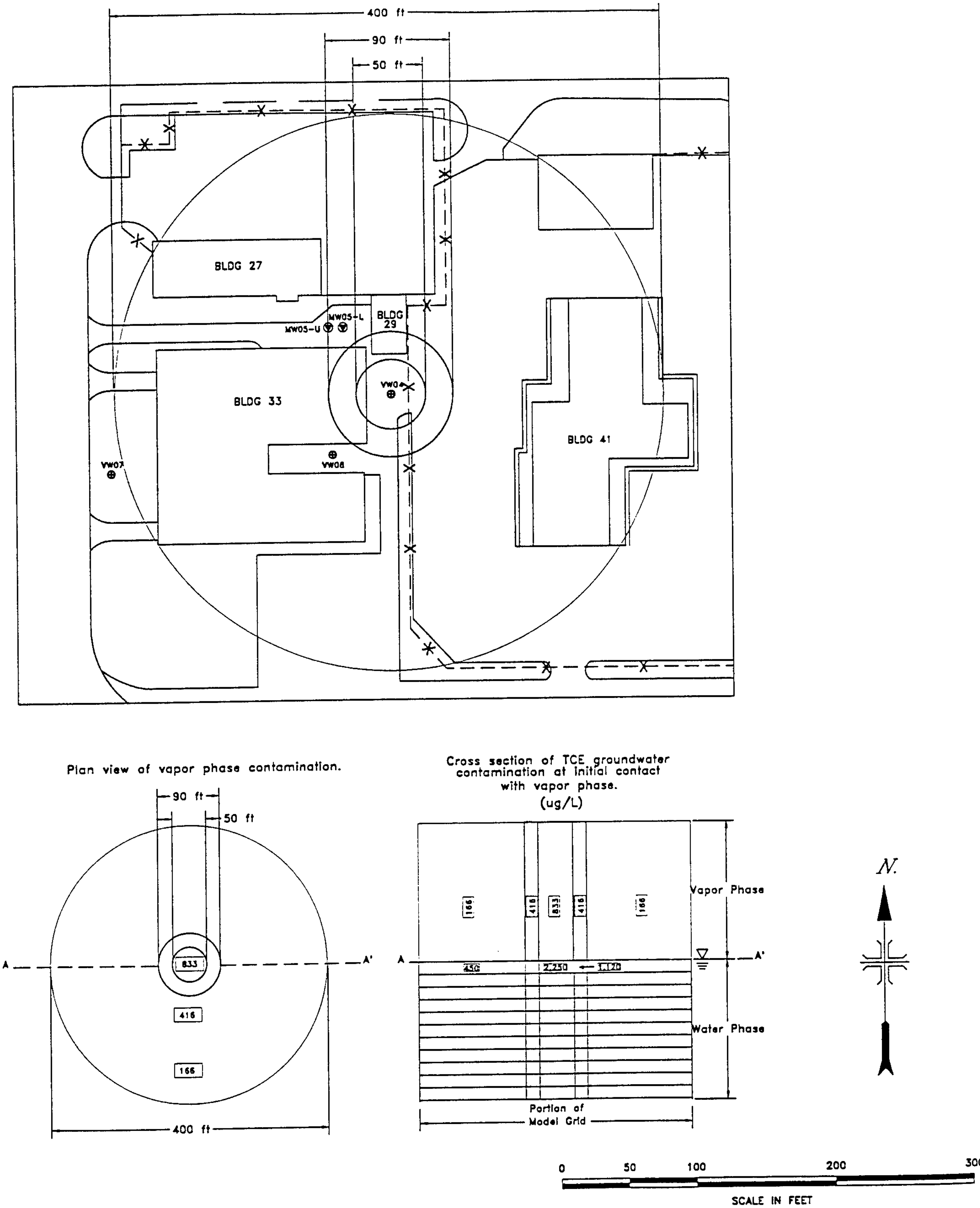

FIGURE A-1
CONCEPTUAL MODEL FOR VADOSE ZONE MODELING PERFORMED BY ORNL/ETS

Compiled by ERM from AANG RI Report, Draft Final – October 1994

DATE	SCALE	DRAWING NUMBER	JOB NUMBER
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ENVIRONMENTAL RESOURCES MANAGEMENT – WEST

ERM

$$C/Co = \frac{1}{b-a}\left(2\sqrt{D^{*}t}\right)\left[\frac{x}{2\sqrt{D^{*}t}} - \frac{x}{2\sqrt{D^{*}t}}\, erf\left(\frac{x}{2\sqrt{D^{*}t}} + \frac{1}{\sqrt{\pi}}\, e^{-\left(\frac{x}{2\sqrt{D^{*}t}}\right)^{2}}\right)\right]_{a}^{b}$$

where:

C = concentration in water;

Co = initial concentration in water;

D^* = diffusion coefficient of 0.17 ft^2/year;

a = top of aquifer (0 feet);

b = base of aquifer (12 feet);

t = time of transport (0.0629 year); and

x = distance traveled in aquifer.

Time available for transport is determined by the size of the source area and the ground water flow velocity. Using this approach, a source area with a diameter of 50 feet containing an average TCE vapor concentration of 833 µg/l coupled with a ground water flow velocity of 795 feet per year predicted a value of approximately 10 µg/l TCE at the downgradient well MW05-U. This compares favorably with actual values of 0.8 to 8.5 µg/l.

Numerical Solution - PORFLOW

To verify the analytical method, mass-transport simulations were carried out using the computer code PORFLOW Version 2.5, which is a numerical simulation tool for solving ground water flow and mass-transport problems. A two-dimensional model was conceptualized, representing a vertical slice through the centroid of the a circular source of TCE at the water table (A to A' on Figure A-1). The flow field was approximated as horizontal and isotropic, with an average linear velocity of 795 feet per year. The effective porosity was assumed to be 0.20, and depth of the flow field of interest, over which simulated ground water concentration will be averaged, was assigned a value of

12 feet. These values are consistent with those described above for the analytical solution and reflect data collected at the AANG Base.

As with the analytical solution, introduction of TCE to the saturated zone is assumed to occur via a partitioning process between TCE vapor and the water-table surface. In the numerical analysis, it was necessary to specify a finite depth to which the initial concentration occurs at this surface. A depth of 0.1 feet was chosen to minimize the spreading or mixing artificially imposed by discretization.

A range of diffusion coefficients and dispersivities was assumed in the numerical simulations due to the large uncertainty in the most appropriate value of these parameters for Site 5. Since the grain-size distribution ranges from 0.003 to 0.3 inches, laboratory-scale dispersivity can be expected to be of the same order of magnitude. Over a distance of about 1 foot, the field-scale dispersivity can be expected to be relatively small, and possibly on the order of the laboratory-scale dispersivity if the porous media is fairly uniform in this region around the source. Unlike diffusion, mechanical dispersion is anisotropic and scale dependent, increasing with length of scale of the domain of interest. Therefore, laboratory measurements of dispersivities reflect the pore-scale phenomena, but may also reflect some of the larger-scale heterogeneities of the porous medium. The correct values used for computational purposes are extremely elusive, depending to a great extent on the scale of the problem.

The results of the numerical simulations for the different parameter values assumed are reported in Table A-1.

The average concentration over the 12-foot thickness of the upper subunit depth is calculated at a distance approximately 20 feet from the center of the source specified. The calculated concentrations in simulation runs 1, 2, 3, 4, and 7 are comparable with the range of TCE concentrations (0.8 to 8.5 μg/l) obtained from downgradient well samples (MW05-U).

The good agreement between the analytical and numerical methods and between these and the observed values in MW05-U indicates that the sources of ground water contamination are adequately defined. Further, it is apparent that vapor transport can be responsible for low levels (tens of μg/l) of ground water contamination. However, considering the high levels of TCE vapor and the relatively low ground water values resulting from the TCE vapor observed at Site 5, a significantly more concentrated source would be required to support the ground water contamination observed at Sites 4 and 7. In other words, if the observed TCE vapor observed at Site 5 can only support

TABLE A-1

Summary of Results of Numerical Simulations

Simulation Run Identifier	Effective Diffusion Coefficient, Assumed (feet2/year)	Longitudinal Dispersivity, Assumed (feet)	Transverse Dispersivity, Assumed (feet)	Average TCE Concentration Predicted (µg/l)
Run 1	0.17	0.0	0.0	13
Run 2	0.034	0.0	0.0	4.8
Run 3	0.0034	0.0	0.0	0.3
Run 4	0.034	0.001	0.0001	10
Run 5	0.034	0.1	0.01	91
Run 6	0.034	1.0	0.1	290
Run 7	0	0.0002	0.0002	12

µg/l = micrograms per liter
feet2/year = feet squared per year
TCE = Trichloroethylene

ground water TCE concentrations below 10 µg/l, then significantly higher TCE vapor concentrations would be needed to support the observed ground water contamination at Sites 4 and 7.

Numerical Solution - VLEACH

To satisfy regulatory concerns regarding advective transport and estimation of future impacts to ground water contamination not considered in the previous analytical and numerical solutions, a one dimensional vadose zone leaching model (VLEACH) coupled with a mixing cell model was applied using the same soil vapor data.

As the name VLEACH implies, liquid leaching or advection, is the driving force behind the model. Based on the simulations presented in the RI Report, the recharge or infiltration rate applied to VLEACH controls the contaminant flux rate at the water table. The contaminant flux rates are then input into a mixing cell using characteristics of the aquifer such as hydraulic conductivity (K), gradient, porosity, etc., where K is the dominant factor in the predicted ground water contaminant concentrations.

Actual infiltration rates specific to Site 5 are not available and would result from a very complex set of parameters if calculated. Therefore, an average value somewhere between 0.1 percent and 10 percent of the annual precipitation rate is typically used. The EPA-provided infiltration rate of 6 percent or 0.7 inches per year is based on VLEACH simulations performed at another Arizona Superfund Site and has, therefore, been extrapolated for use at the Arizona ANG. Selection of a K value of 100 feet/day is based on analysis of pumping test data collected during the RI.

To demonstrate the sensitivity of the infiltration and conductivity parameters, VLEACH simulations using the TCE soil vapor data from the vapor wells (VW04, VW07, and VW08) and infiltration rates of 0.1 percent (0.01 inches per year), 1 percent (0.1 inches per year), and 6 percent (0.7 inches per year) were coupled with K values of 1, 10, and 100 feet/day in the mixing cell. Of the three K values, the 100 feet/day most closely matches the results of the pumping test derived K of 113 feet/day for the upper subunit. The results of the VLEACH/mixing cell simulations are presented show predicted TCE concentrations ranging from less than 1 to over 500 µg/l. Evaluating the predicted TCE concentrations in ground water resulting from the VLEACH/mixing cell simulations requires considerable objectivity, particularly from a risk assessment standpoint. The inappropriate combination of the two controlling input parameters results in unrealistic over-predictions of

ground water contamination impacts and can lead to unnecessary remediation efforts. However, for the purpose of evaluating the vadose zone to ground water pathway at Site 5 using VLEACH, the use of the 0.7 inches per year infiltration rate is acceptable based on precedence at another arid site in Arizona.

The selection of a justifiable K value for the simulations is relatively straightforward given that K values from pumping tests are preferred and more reliable than K values resulting from slug tests. The worst case simulation using 0.7 inches per year and 1 foot/day combination results in a predicted ground water TCE concentration in excess of 500 μg/l which is a considerable overprediction considering the same infiltration rate coupled with a hydraulic conductivity of 100 feet/day results in a predicted peak TCE concentration in ground water of 5.3 μg/l. As discussed earlier, a hydraulic conductivity of 100 feet/day was calculated based on pumping test data and is considered the best estimate of hydraulic conductivity.

ERM Modeling

ERM performed additional vadose zone modeling in order to define a cleanup goal for Site 5 soils. ERM used VLEACH to evaluate various alternative cleanup goals to determine the resulting ground water concentrations. ERM chose to model TCE transport only because previous modeling conducted by ORNL/ETS suggested that transport of tetrachloroethylene (PCE) through the vadose zone would not result in ground water concentrations exceeding maximum contaminant levels for this compound. In running the model, ERM utilized the same methods as ORNL/ETS used during the RI. Details regarding the modeling assumptions and parameters are included in Appendix N of the *Final Remedial Investigation Report, 162nd Fighter Group, Arizona Air National Guard, Tucson, Arizona (June 1995)*.

For the purpose of modeling, ERM used the ORNL/ETS's conceptual model for distribution of TCE in soil vapor at Site 5 (Figure A-1). In summary, the TCE soil vapor concentrations were conceptualized as a circular area with three circular concentration zones, identified as the inner, intermediate, and outer zones.

ERM utilized the same input parameters for soil physical conditions as used by ORNL/ETS during its VLEACH modeling. The recharge rate was assumed to be 0.7 inches per year. The VLEACH input parameters are summarized on Table A-2. Three alternative cleanup goal

scenarios were modeled: 500, 250, and 125 µg/l. The results of the VLEACH analysis are included in Table A-2.

ORNL/ETS's mixing cell model was used to compute the resulting ground water concentration based on the mass delivered from the vadose zone, as projected by the VLEACH model. Aquifer K was assumed to be 100 feet/day. The mixing cell input parameters are summarized on Table A-2. The calculated ground water impacts under the alternative cleanup goal scenarios are also included in Table A-2. In summary, the projected ground water impacts under the 500 µg/l scenario exceeded the 5 µg/l in-situ cleanup goal for TCE in ground water. The 250 µg/l scenario resulted in projected ground water impact of 4.8 µg/l, approximately equal to the in-situ cleanup goal. The projected ground water impact under the 125 µg/l scenario was 3.6 µg/l.

ERM selected a TCE cleanup goal of 200 µg/l. This concentration is intermediate to the two scenarios that resulted in an impact to ground water of less than 5 µg/l. This cleanup goal will be used to define areas of Site 5 soil requiring remediation as well as a basis for cost estimates for the soil vapor extraction remedial alternatives.

TABLE A-2

Results of ERM Modeling

			Cleanup Goal Alternatives					
Existing Condition			Alternative 1		Alternative 2		Alternative 3	
ORNL/ETS TCE MODEL			500 µg/l Soil Gas		250 µg/l Soil Gas		125 µg/l Soil Gas	
Time (years)	Flux Rate g/day/ft2*E-06	Ground Water Concentration µg/l	Flux Rate g/day/ft2*E-06	Ground Water Concentration µg/l	Flux Rate g/day/ft2*E-06	Ground Water Concentration µg/l	Flux Rate g/day/ft2*E-06	Ground Water Concentration µg/l
10	1.77	5.3	1.72	5.1	1.62	4.8	1.19	3.6
20	1.76	5.2	1.71	5.1	1.61	4.8	1.18	3.5
30	1.74	5.2	1.69	5.0	1.6	4.8	1.17	3.5
40	1.71	5.1	1.66	5.0	1.57	4.7	1.15	3.4
50	1.68	5.0	1.63	4.9	1.54	4.6	1.13	3.4
60	1.64	4.9	1.6	4.8	1.51	4.5	1.1	3.3
70	1.61	4.8	1.56	4.7	1.48	4.4	1.08	3.2
80	1.58	4.7	1.53	4.6	1.45	4.3	1.06	3.2
90	1.54	4.6	1.5	4.5	1.42	4.2	1.04	3.1
100	1.51	4.5	1.47	4.4	1.39	4.1	1.02	3.0

Assumptions:

Same parameters used in the VLEACH model for Site 5 TCE as provided by ORNL/ETS in Appendix N (Table 2-1) of the Final Remedial Investigation Report.

Recharge Rate assumed to be 0.7 inches per year.

Same parameters used in mixing cell model as provided by ORNL/ETS is in Appendix N (Table 6-1) of the Final Remedial Investigation Report.

Upper subunit hydraulic conductivity assumed to be 100 feet per day.

Polygons used in the VLEACH model as follows:

	TCE Concentration, µg/kg		
Simulation	Inner Zone	Intermediate Zone	Outer Zone
ORNL/ETS	328	163	65
Alternative 1	197	163	65
Alternative 2	98	98	65
Alternative 3	49	49	49

g = grams
ft2 = feet squared
E-06 = multiply by a factor of 10-6
µg/l = micrograms per liter
µg/kg = micrograms per kilogram
ORNL/ETS = Oak Ridge National Laboratory/Environmental Technology Section
TCE = Trichloroethylene

APPENDIX B

POTENTIAL ARARS PROVIDED BY THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Fife Symington, Governor Edward Z. Fox, Director

February 9, 1995 E - 4130.4

FFU95,029

Michael G. Grimm, Project Manager
ANGRC/CEVR
3500 Fetchet Avenue
Andrews AFB, MD 20331-5717

RE: Potential Arizona Applicable or Revelant and Appropriate Requirements (ARARs) for the 162nd Arizona Air National Guard (AANG)

Dear Mr. Grimm:

In response to your request, the Arizona Department of Environmentat Quality (ADEQ) sends you the attached list of potential Arizona ARARs. This is not a complete list, but includes most of the critical ARARs. We have not as yet solicited other agencies for ARARs or rules to be considered (TBCs). The list we are sending now should enable you to do design work that will not need to be changed due to future ARARs. However, ADEQ does reserve the right to submit additional ARARs as the project develops and prior to the signing of the final ROD. You may also note that many of the ARARs submitted do not obviously apply at this time. These are being submitted in as much as circumstances may develop where they would be necessary.

Sincerely,

Richard A. Jenkins

Richard A. Jenkins, P.E.
Project Manager,
Federal Facilities Unit

w/attachment

cc: Faye Troisi, ADEQ, Hydrologist

POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

162nd Air National Guard Facility
Tucson International Airport
Tucson, Arizona

Chemical-Specific ARARS:

Safe Drinking Water Act 42 U.S.C.A. §§ 300f to 300j-11 and the rules promulgated thereunder.
ARAR
REQUIREMENT:
After remedial action, the contaminants remaining in the aquifer(s) shall be in compliance with the following maximum contaminant levels (MCLs) stated at 40 CFR 141.11 [56 FR 32112, July 15, 1991]:

Arsenic	.05	mg/l
Barium	1.0	mg/l
Chromium	.05	mg/l
Lead	.05	mg/l
Mercury	.002	mg/l
Nitrate	10.0	mg/l

the MCLs stated at 40 CFR 141.12 [57 FR 31776, July 17, 1992]:

Total trihalomethanes, including Chloroform	.1	mg/l

the MCLs stated at 40 CFR 141.61 [59 FR 3320, July 1, 1994]:

o-Dichlorobenzene (1,2-dichlorobenzene (DCB2))	.6	mg/l
trans-1,2-Dichloroethylene	.1	mg/l
1,2-Dichloroethane (1,2-DCA)	.005	mg/l
Trichloroethylene (TCE)	.005	mg/l
1,1-Dichloroethylene (1,1-DCE)	.007	mg/l
1,1,1-Trichloroethane (TCA)	.2	mg/l
Tetrachloroethylene	.005	mg/l
Dichloromethane (methylene chloride)	.005	mg/l
Benzene	.005	mg/l
Monochlorobenzene (Chlorobenzene (CB))	.1	mg/l
Vinyl Chloride	.002	mg/l
Carbon tetrachloride	.005	mg/l

the MCLs stated at 40 CFR 141.62 [57 FR 31776, July 17, 1992]:

Fluoride	4.0	mg/l

Safe Drinking Water Act 42 U.S.C.A. §§ 300f to 300j-11 and the rules promulgated thereunder.

To Be Considered
REQUIREMENT:
After remedial action, the contaminants remaining in the aquifer(s) shall be in compliance with the following secondary maximum contaminant levels (SMCLs) stated at 40 CFR 143.3 [56 FR 3526, January 30, 1991]:

Chloride	250.0	mg/l
Sulfate	250.0	mg/l
Total dissolved solids	500.0	mg/l

Health-Based Guidance Levels (HBGLS) (Water)
TBCs
CITATION: "Human Health-Based Guidance Levels for Contaminants in Drinking Water and Soil" (January 1995 Update)
REQUIREMENT: The Arizona Department of Health Services database printout document entitled "Human Health-Based Guidance Levels for Contaminants in Drinking Water and Soil" (January 1995 Update) lists health-based guidance levels (HBGLS) for chemicals in drinking water and soils. The HBGLs represent human ingestion levels that are unlikely to result in adverse health effects during long-term exposure. These are guidelines for soil and groundwater cleanup levels. For remedial action, the following health based guidance levels shall be considered for cleanup levels for the contaminants in the aquifer(s), that is:

Arsenic	.02	μg/l
Barium	490.0	μg/l
Chromium VI	35.0	μg/l
Lead	5.0	μg/l
Mercury	2.1	μg/l
Nitrate	11000.0	μg/l
Chloroform	5.7	μg/l
trans-1,2-Dichloroethylene	140.0	μg/l
1,2-Dichloroethane (1,2-DCA)	.38	μg/l
Trichloroethylene (TCE)	3.2	μg/l
1,1-Dichloroethylene (1,1-DCE)	.06	μg/l
Tetrachloroethylene	.70	μg/l
Methylene chloride (Dichloromethane)	4.7	μg/l
Benzene	1.2	μg/l
Vinyl Chloride	0.02	μg/l
Carbon tetrachloride	0.27	μg/l
Fluoride	420.0	μg/l
Sulfate	400000.0	μg/l

Safe Drinking Water Act 42 U.S.C.A. §§ 300f to 300j-11 and the rules promulgated thereunder.

To Be Considered
REQUIREMENT:
After remedial action, the contaminants remaining in the aquifer(s) shall be in compliance with the following secondary maximum contaminant levels (SMCLs) stated at 40 CFR 143.3 [56 FR 3526, January 30, 1991]:

Chloride	250.0	mg/l
Sulfate	250.0	mg/l
Total dissolved solids	500.0	mg/l

Health-Based Guidance Levels (HBGLS) (Water)
TBCs
CITATION: "Human Health-Based Guidance Levels for Contaminants in Drinking Water and Soil" (January 1995 Update)
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Arsenic	.02	µg/l
Barium	490.0	µg/l
Chromium VI	35.0	µg/l
Lead	5.0	µg/l
Mercury	2.1	µg/l
Nitrate	11000.0	µg/l
Chloroform	5.7	µg/l
trans-1,2-Dichloroethylene	140.0	µg/l
1,2-Dichloroethane (1,2-DCA)	.38	µg/l
Trichloroethylene (TCE)	3.2	µg/l
1,1-Dichloroethylene (1,1-DCE)	.06	µg/l
Tetrachloroethylene	.70	µg/l
Methylene chloride (Dichloromethane)	4.7	µg/l
Benzene	1.2	µg/l
Vinyl Chloride	0.02	µg/l
Carbon tetrachloride	0.27	µg/l
Fluoride	420.0	µg/l
Sulfate	400000.0	µg/l

Safe Drinking Water Act 42 U.S.C.A. §§ 300f to 300j-11 and the rules promulgated thereunder.

To Be Considered
REQUIREMENT:
After remedial action, the contaminants remaining in the aquifer(s) shall be in compliance with the following secondary maximum contaminant levels (SMCLs) stated at 40 CFR 143.3 [56 FR 3526, January 30, 1991]:

Chloride	250.0	mg/l
Sulfate	250.0	mg/l
Total dissolved solids	500.0	mg/l

Health-Based Guidance Levels (HBGLS) (Water)
TBCs
CITATION: "Human Health-Based Guidance Levels for Contaminants in Drinking Water and Soil" (January 1995 Update)
REQUIREMENT: The Arizona Department of Health Services database printout document entitled "Human Health-Based Guidance Levels for Contaminants in Drinking Water and Soil" (January 1995 Update) lists health-based guidance levels (HBGLS) for chemicals in drinking water and soils. The HBGLs represent human ingestion levels that are unlikely to result in adverse health effects during long-term exposure. These are guidelines for soil and groundwater cleanup levels. For remedial action, the following health based guidance levels shall be considered for cleanup levels for the contaminants in the aquifer(s), that is:

Arsenic	.02	μg/l
Barium	490.0	μg/l
Chromium VI	35.0	μg/l
Lead	5.0	μg/l
Mercury	2.1	μg/l
Nitrate	11000.0	μg/l
Chloroform	5.7	μg/l
trans-1,2-Dichloroethylene	140.0	μg/l
1,2-Dichloroethane (1,2-DCA)	.38	μg/l
Trichloroethylene (TCE)	3.2	μg/l
1,1-Dichloroethylene (1,1-DCE)	.06	μg/l
Tetrachloroethylene	.70	μg/l
Methylene chloride (Dichloromethane)	4.7	μg/l
Benzene	1.2	μg/l
Vinyl Chloride	0.02	μg/l
Carbon tetrachloride	0.27	μg/l
Fluoride	420.0	μg/l
Sulfate	400000.0	μg/l

No fedral standard exists for these contaminants

Trichlorotrifluoroethane (Freon 113)	210000.0	µ/l
Boron	630.0	µ/l

Health-Based Guidance Levels (HBGLS) (Soil)
TBC
CITATION: "Human Health-Based Guidance Levels for Contaminants in Drinking Water and Soil" (January 1995 Update)
REQUIREMENT: The Arizona Department of Health Services database printout document entitled "Human Health-Based Guidance Levels for Contaminants in Drinking Water and Soil" (January 1995 Update) lists health-based guidance levels (HBGLS) for chemicals in drinking water and soils. The HBGLs represent human ingestion levels that are unlikely to result in adverse health effects during long-term exposure. These are guidelines for soil and groundwater cleanup levels. For remedial action cleanup levels, the following health based guidance levels shall be considered. No federal standard exists for these contaminants in soils.

Trichloroethylene (TCE)	120.0	mg/kg
1,1-Dichloroethylene (1,1-DCE)	2.3	mg/kg
Tetrachloroethylene	27.0	mg/kg

APPLICABLE: The above contaminants are in the soil at the site. HBGLs are a set of consistently-derived healthbased guidance levels which have not been subjected to the Arizona rule-making process. Since there are no federal standards for the cleanup of the above-identified contaminants in soil, the HBGLs are more stringent and thus are the standard for cleanup.

Location-specific ARARs

Endangered Species
ARAR
CITATION: 16 U.S.C. §1531 et seq.
REQUIREMENT: Remedial actions shall comply with requirements for endangered species in accordance with the Endangered Species Act.

Fish and Wildlife
ARAR
CITATION: 16 U.S.C. §661 et seq., 40 CFR §6.302
REQUIREMENT: Remedial actions shall protect the fish and wildlife of the area in accordance with the 16 U.S.C. §661 et seq.

Artifacts
ARAR
CITATION: National Archeological and Historical Preservation Act, 16 U.S.C. §469, 36 CFR Part 65, and A.R.S §41-841 thru §41-847 and A.R.S. §41-865
REQUIREMENT: The laws governing archaeological discovery and preservation shall be followed if artifacts or human remains are discovered.

Action-specific ARARs

Arizona Water Quality control
ARAR
CITATION: Arizona Revised Statutes. Title 49 (A.R.S. §49-224)
REQUIREMENT: All aquifers in the state are classified as drinking water aquifers. As such, the goal of remediation is to restore the affected aquifer to drinking water quality with regard to chemical contamination.
RELEVANCY: Arizona law is more stringent than Federal standards. The preferred alternative must meet this ARAR. This ARAR has been presented and made an ARAR in the ROD of every NPL site in the state that has an approved ROD.

New Well Construction & Groundwater.Use Requirements
ARAR
CITATION: 45 A.R.S. §454.01
REQUIREMENTS: This section exempts new well construction and withdrawal, treatment and reinjection of groundwater from certain requirements of Title 45 only when they are a part of, and on the site of, a remedial action undertaken pursuant to CERCLA. However, it expressly maintains the following requirements: 1) a new well is subject to sections 45-594 (Well construction standards); 45-595 (Well construction requirements; licensing of well drillers and pump installation contractors) and 45-596 (Notice of intention to drill), but no authorization to drill need to be obtained before drilling; 2) if the groundwater that is withdrawn is not reinjected into the aquifer, the groundwater shall be put to reasonable and beneficial use, and 3) a person who uses groundwater withdrawn in an active management area in this situation shall pay the withdrawal fee and shall use the groundwater only pursuant to Articles 5 through 12 of Title 45, Chapter 2; and 3.
RELEVANCY: While A.R.S. S 45-454.01 waives some of the requirements of Title 45 at NPL Sites, significant requirements still apply.

Remedial Action Requirements
ARAR
CITATION: 49 A.R.S. §282
REQUIREMENT: Remedial actions must (a) assure the protection of public health and welfare and the environment; (b.) to the extent practicable, provide for the control and management of clean-up of the hazardous substance so as to allow the maximum beneficial use of the waters of the state; and (c) be cost effective over the period of potential exposure to such hazardous substance.

Groundwater Withdrawal Permit
ARAR
CITATION: A.R.S. §§45-511 through 528
REQUIREMENT: If groundwater must be withdrawn, it may be necessary to obtain groundwater withdrawal permits from the Arizona Department of Water Resources if the exemption provided by 45-454.01 does not apply to the remedial project. A Hydrologic Testing permit (A.R.S. §45-519.01) and a Poor Quality Groundwater Withdrawal Permit (A.R.S. §45-516), for example, may be required under Title 45.

Air Emissions
ARAR
CITATION: Pima County Air Quality Control Regulations, and/or 40 CFR 264, Subparts AA and BB.
REQUIREMENT: During remediation of soil and groundwater, air emissions shall be treated to meet Pima County Air Quality Standards as dictated by the Clean Air Act and/or 40 CFR 264, Subparts AA and BB.

Discharge to POTW
ARAR
CITATION: 40 CFR 403 and 40 CFR 122.41 (i).
REQUIREMENT: Discharge of effluent to public treatment works must comply with the requirements of 40 CFR 403 and meet Pima County Waste Water Management permitting standards and will be monitored in accordance with 40 CFR 122.41 (i).

Discharge to Aquifer
ARAR
CITATION: A.R.S. §49-241 et seq.
REQUIREMENT: Any person who discharges shall obtain an Aquifer Protection Permit, A.R.S. §49-241 et seq. Since, under CERCLA, the requirement to get a permit is waived, the substantive provisions of the permit must be met. Included in the list of "discharges", among others, are surface impoundments, including holding, storage settling, treatment or disposal pits, ponds and lagoons; solid waste disposal facilities; injection wells.

Disposal of Wastes ARAR
To be supplied

Waste Treatment Technology ARAR
To be supplied

Air stripper Emissions
ARAR
CITATION: EPA OSWER Directive 9355.0-2.8, June 1989
REQUIREMENT: Controls are needed on most sources with an actual emissions rate of 3 lb/hr or 15 lb/day or a potential rate of 10 tons per year of total VOCs because VOCs are ozone precursors. The basis of the need for control indicates that this guidance should be considered for SVE emissions as well as air stripper emissions.

"Contained in" principle
ARAR
CITATION: RCRA
REQUIREMENT: Management of nonwaste material containing a listed hazardous waste - RCRA "contained in" principle. The nonwaste material must be managed as if it were a hazardous waste.

Treatment by Granular Activated Carbon Adsorption
Solid Waste Disposal Act, as amended by Resource Conservation and Recovery Act, 42 U.S.C. § 6901 et seq.:

Use of granular activated carbon (GAC) for remediation of VOCs triggers requirements associated with regeneration or disposal of the spent carbon. RCRA is relevant and appropriate. Spent carbon is a characteristic waste. It is regulated as a hazardous waste under RCRA. Spent carbon must be disposed of at a permitted hazardous waste disposal facility.

Containers used for storage of hazardous waste on site for more than 90 days must be:

- Maintained in good condition (40 CFR § 264.171);
- Compatible with other stored wastes (40 CFR § 264.172);
- Closed during storage (40 CFR § 264.173)
- Placed on a sloped, crack-free base with containment system in place capable of handling 10 percent of the free liquids stored (40 CFR §264.175)
- Placed 50 feet from the facility's property line if ignitable or reactive (40 CFR §264.176);
- Separated by a dike or other barrier if incompatible wastes are stored near each other (40 CFR §264.178)
- At closure, all hazardous wastes and residues from contaminant system must be removed (40 CFR §264.178);
- Storage of banned wastes must be in accordance with 40 CFR §268 (40 CFR §268.50).

On site storage of contaminated carbon
CITATION: A.R.S. 49-921 et seq and AAC R18-8-260 et seq.
REGULATION: On site storage of contaminated carbon must be in compliance with state hazardous waste laws. Secondary containment is required for storage of hazardous wastes over 90 days. Since the spent carbon is a hazardous waste, construction and monitoring requirements for storage facilities also apply.

RCRA and Hazardous Solid Waste Amendment (HSWA) Standards (42 U.S.C. §§6901-6987):
Remedial activities that involve the excavation or removal of hazardous wastes, on-site management of these substances, or removal to off-site facilities must be in compliance with standards under RCRA and amendments to RCRA enacted through the HSWA standards, and with the requirements of the State standards authorized under RCRA. Any soil found contaminated with VOCs must be disposed of in accordance with RCRA.

The following RCRA sections may be relevant and appropriate to remedial actions for the site.

- Hazardous Waste Management System: General (40 CFR Part 260)
- Identification and Listing of Hazardous Waste (40 CFR Part 261)
- Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (40 CFR Part 264, in particular:

  Subpart B - General Facility Standard
  Subpart C - Preparedness and Prevention

Subpart E - Manifest System, Record-Keeping, and Reporting for Offsite Transport and Disposal
Subpart F - Groundwater Monitoring
Subpart G - Closure and Postclosure
Subpart I - Use and Management of Containers
Subpart L - Waste Piles
Subpart X - Miscellaneous Units

- Land Disposal Restrictions (40 CFR Part 268)
  HSWA restricts the land disposal of hazardous waste and specifies (in subpart D) treatment standards that must be met before these wastes can be land disposed.

Used Oil as Fuel
ARAR
CITATION: A.R.S. §49-801 et seq.
REQUIREMENT: In the event the facility chooses to use used oil as a fuel it must meet the requirements of A.R.S. S 49-801 et seq.

APPENDIX C

COST ESTIMATES FOR REMEDIAL ALTERNATIVES

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APPENDIX C

COST ESTIMATES FOR REMEDIAL ALTERNATIVES

This section provides the assumptions used in determining costs for soil vapor extraction (SVE) treatment alternatives 2A through 2C.

Influent Stream Characteristics

Ambient Conditions	70 °F, 13.38 psia @2,560 feet above msl.
Soil Vapor Extraction Rate	200 standard cubic feet per minute (scfm).

Table C-1 presents influent stream characteristics for TCE, PCE, and 1,1,1 TCA.

Vapor Extraction System Assumptions

Extraction Wells	Five new vapor extraction well clusters will include 2-inch diameter wells screened 15 to 35, 40 to 60, and 65 to 85 feet bgs.
Foundation	40 feet long by 20 feet wide concrete pad. Must support static load from two equipment skids.
Fencing	120 LF to include 10-foot wide double-drive gates.
Pipe Trench	300 LF, 4-inch diameter extraction pipe manifold from well clusters to the equipment pad 1'w x 3'd sawcut, compacted backfill & concrete finish.
Vacuum Blower	10-hp, -6"Hg max positive displacement blower.
Electrical Panel	3 ø, 240/480 VAC service, 200 A distribution sub-panel.

TABLE C-1

Initial Influent Stream Characteristics

Constituents	TCE	PCE	1,1,1-TCA
Molecular Weight	131.4	165.8	133.4
Concentration	2,140 µg/l	102 µg/l	30 µg/l
	432 ppmv	16 ppmv	6 ppmv
Mass Loading	38.5 lbs/d	1.8 lbs/d	0.54 lbs/d

Alternative 2A - SVE with Catalytic Oxidation

The following sections describe assumptions used in computing the cost estimate for Alternative 2A - SVE with Catalytic Oxidation.

Cost Factors

- From the quoted system price of $140,000, list prices were separated for process units as the moisture knockout vessel, vacuum pump, electrical control panes, and caustic scrubber option.
- Maintenance labor entails four man-days a month for process adjustments, blower preventive maintenance, air emissions sample collection, portable and dedicated instrument calibration.
- Shipping is included in the $7,000 mobilization lump sum.
- Both natural gas and electrical utilities will be required.
- Maximum natural gas consumption for the CATOX preheater is based on data from vendor's quote.
- Natural gas billing rate of $0.47 per therm. The CATOX was assumed to require 7,765 therms annually.
- Replacement of the catalyst is assumed to occur once.
- Utility and operating labor costs were assumed to be uniform over a five-year project lifetime using 5 percent interest.

Cost Estimates

The cost estimate for SVE with catalytic oxidation alternative is included in Table C-2.

Alternative 2B - SVE with Activated Carbon

Wheelabrator Clean Air Systems, Inc. provided the material usage rate modeling results and cost estimates for three, 1800-pound carbon adsorber vessels to be connected in series. Based on the startup vapor concentrations above, the number of days a vessel is used before changeout is 14 days. After five years of operation (t=5), carbon consumption would have decreased from 130 lbs/d to 60 lbs/d assuming a corresponding drop in influent soil vapor concentrations.

TABLE C-2

Cost Estimate for Alternative 2A - SVE with Catalytic Oxidation

Description	Quantity	Units	Unit Cost	Cost	Subtotal
Permit Application and Fees					$7,000
County Bldg Insp Div (Fire)				$1,000	
ADEQ air permit				$6,000	
Equipment, Materials, and Labor					$261,940
Mobilization	1	l.s.	$7,000	$7,000	
Concrete Foundations	400	s.f.	$25	$10,000	
Fencing	120	l.f.	$12	$1,440	
Vadose Extraction Wells	900	l.f.	$70	$63,000	
SVE piping	300	l.f.	$12	$3,600	
Trenching	300	l.f.	$43	$12,900	
Moisture Knock-out	1	each	$1,000	$1,000	
Wellhead Vault & Valving	5	each	$1,360	$6,800	
Vacuum Blower	1	each	$6,000	$6,000	
Catalytic Oxidizer skid	1	each	$83,000	$83,000	
Discharge Stack	40	l.f.	$25	$1,000	
Discharge Stack Erection	1	each	$4,000	$4,000	
Acid Scrubber option	1	each	$30,000	$30,000	
System Control Panels	2	each	$10,000	$20,000	
Electrical Service & Lighting	1	l.s.	$6,200	$6,200	
Natural Gas Service	1	l.s.	$3,000	$3,000	
Demobilization	1	l.s.	$3,000	$3,000	
O&M for 5 years, 5% interest: (Annual costs shown below)					$370,550
Electricity	63045	KWhr	$0.10	$6,305	
Natural Gas	7,765	therm	$0.47	$3,650	
Catalyst Replacement	1	each	$2,000	$2,000	
Soda Ash	109500	lb	$0.10	$10,950	
Makeup water	400	gpd	$0.02	$3,650	
Maintenance	12	months	$2,792	$33,504	
Analytical Services	12	months	$1,100	$14,700	
Non-hazardous Matl Disposal	1	drum	$39	$39	
Data Eval & QMR Reports	12	mo	$900	$10,800	

Subtotal	$639,490
Engineering Design @ 10%	$63,949
Construction Mgmt @ 10%	$63,949
Contingencies @ 50%	$319,745
TOTAL COST	**$1,087,132**

Cost Factors

- Purchase price is $5,680 per Westates Model VSC-2000 vessel.
- Freight is included in the $3,000 mobilization lump sum.
- Material changeout is quoted at $2,680 per vessel. This service price includes fresh carbon replacement on-site, disposal transport of spent material and processing at Wheelabrator's Parker Regeneration Facility.
- Electricity is the only utility required.
- Operating utility and maintenance labor costs were assumed to be uniform over a five-year project lifetime.
- Carbon material usage rate is assumed to linearly decrease over time.
- Corresponding material costs were assumed to linearly decrease to zero at the end of 5 years as follows:

Year	Number of Changeouts	Changeout Annual Cost
1	26	$69,680
2	21	$55,744
3	16	$41,808
4	10	$27,872
5	5	$13,936

Cost Estimates

The cost estimates for SVE with activated carbon alternative is included in Table C-3.

Alternative 2C - SVE with No Off Gas Treatment

King, Buck and Associates and Pego Systems provided price quotes on generic 200 scfm blower system.

TABLE C-3

Cost Estimate for Alternative 2B - SVE with Activated Carbon

Description	Quantity	Units	Unit Cost	Cost	Subtotal
Permit Application and Fees					$7,000
County Bldg Insp Div (Fire)				$1,000	
ADEQ air permit				$6,000	
Equipment, Materials, and Labor					$139,340
Mobilization	1	l.s.	$3,000	$3,000	
Concrete Foundation	400	s.f.	$25	$10,000	
Fencing	120	l.f.	$12	$1,440	
Vadose Extraction Wells	900	l.f.	$70	$63,000	
SVE piping	300	l.f.	$12	$3,600	
Trenching	300	l.f.	$43	$12,900	
Moisture Knock-out	1	each	$1,000	$1,000	
Wellhead Vault & Valving	5	each	$1,360	$6,800	
Vacuum Blower	1	each	$6,000	$6,000	
Carbon Adsorber Vessels	3	each	$5,800	$17,400	
Discharge Stack	40	l.f.	$25	$1,000	
Discharge Stack Erection	1	each	$4,000	$4,000	
Electrical Service & Lighting	1	l.s.	$6,200	$6,200	
Demobilization	1	l.s.	$3,000	$3,000	
O&M for 5 years, 5% interest: (Annual Costs Shown Below)					$469,775
Electricity	63045	KWhr	$0.10	$6,305	
Maintenance	12	months	$2,792	$33,504	
Analytical Services	12	months	$1,100	$14,700	
Non-hazardous Matl Disposal	1	drum	$39	$39	
Data Eval & QMR Reports	12	mo	$900	$10,800	
Carbon Material Changeout	26	unit	$2,680	$69,680	
With linear decrease in annual consumption					

Subtotal	$616,115
Engineering Design @ 10%	$61,612
Construction Mgmt @ 10%	$61,612
Contingencies @ 50%	$308,058
TOTAL COST	**$1,047,396**

Operating Cost Factors

- Both the vacuum blower and 40-feet tall stack were assumed to be similar to those considered in the CATOX and carbon alternatives.
- Freight is included in the $3,000 mobilization lump sum.
- Electricity is the only utility required.
- Operating utility and maintenance labor costs were assuming to be uniform over a 5-year project lifetime.

Cost Estimates

The cost estimate for SVE with no off gas treatment is presented in Table C-4.

TABLE C-4

Cost Estimate for Alternative 2C - SVE with No Off Gas Treatment

Description	Quantity	Units	Unit Cost	Cost	Subtotal
Permit Application and Fees					$7,000
County Bldg Insp Div (Fire)				$1,000	
ADEQ air permit				$6,000	
Equipment, Materials, and Labor					$115,690
Mobilization	1	l.s.	$3,000	$3,000	
Concrete Foundation	150	s.f.	$25	$3,750	
Fencing	120	l.f.	$12	$1,440	
Vadose Extraction Wells	900	l.f.	$70	$63,000	
SVE piping	300	l.f.	$12	$3,600	
Trenching	300	l.f.	$43	$12,900	
Moisture Knock-out	1	each	$1,000	$1,000	
Wellhead Vault & Valving	5	each	$1,360	$6,800	
Vacuum Blower	1	each	$6,000	$6,000	
Discharge Stack	40	l.f.	$25	$1,000	
Discharge Stack Erection	1	each	$4,000	$4,000	
Electrical Service & Lighting	1	l.s.	$6,200	$6,200	
Demobilization	1	l.s.	$3,000	$3,000	
O&M for 5 years, 5% interest: (Annual Costs Shown Below)					$258,837
Electricity	63045	KWhr	$0.10	$6,305	
Maintenance	12	months	$2,329	$27,948	
Analytical Services	12	months	$1,100	$14,700	
Non-hazardous Matl Disposal	1	drum	$39	$39	
Data Eval & QMR Reports	12	mo	$900	$10,800	

Subtotal	$381,527
Engineering Design @ 10%	$38,153
Construction Mgmt @ 10%	$38,153
Contingencies @ 50%	$190,764
TOTAL COST	**$648,597**

APPENDIX D

RESPONSIVENESS SUMMARY AND EPA COMMENTS

RESPONSE TO EPA COMMENTS ON THE DRAFT FINAL FEASIBILITY STUDY (JULY 1995) AANG BASE, TUCSON, ARIZONA

COMMENT	RESPONSE
EPA Comments: September 7, 1995	

General Comments	
1. Document is consistent with guidance for Presumptive Remedy Feasibility Studies.	Comment Noted.
2. Document presents ERM as decision maker rather than National Guard Bureau (NGB).	ERM will revise the text to clarify that NGB has the decision-making role.
3. Implementation of a Soil Vapor Extraction (SVE) pilot test requires EPA review and approval of a work plan.	The scope of work for the SVE pilot test includes development of a workplan for regulatory agency review.
4. The draft final FS will have to be revised as a final document.	A final FS will be prepared that will include response to the regulatory agencies general and specific review comments.

Specific Comments	
1. COVER: Cover should include Tucson International Airport Superfund Site.	The FS will be revised in response to this comment.
2. EXECUTIVE SUMMARY: Modify text to reflect potential indirect exposure of VOCs via ground water transport.	The FS will be revised in response to this comment.
3. EXECUTIVE SUMMARY: Identify EPA Directives 9355.0-48-FS by title in text.	The FS will be revised in response to this comment.
4 EXECUTIVE SUMMARY: Propose SVE with a specific vapor treatment technology, preferably granular activated carbon (GAC).	The FS will be revised in response to this comment.

COMMENT	RESPONSE
EPA Comments: September 7, 1995	
5. TEXT/SECTION 1.3.2: Specifically acknowledge the use of TCE, TCA, and PCE.	Historic information regarding chemical use at Site 5 is currently included in 1.3.5 . A sentence will be added to the end of the first paragraph under "Site History" to indicate that TCE, TCA, and PCE were detected in soil gas samples collected from the vadose zone underlying Site 5.
6. TEXT/PAGE 1-7: Define TCE when first used.	The FS will be revised in response to this comment.
7. TEXT/SECTION 1.3.5: Change "excepted" to "excerpted".	The FS will be revised in response to this comment.
8. TEXT/PAGE 1-17: The source of TCE to lower subunit ground water could also be Site 5 soils.	Comment noted. The FS only provides restatement of data and analyses of site conditions that was contained in the final Remedial Investigation Report.
9. TEXT/PAGE 1-20: Add text regarding risk via contaminant migration to ground water.	The FS will be revised in response to this comment.
10. TEXT/PAGE 2-2: The term "on-site" means where contamination has come to be located both on- and off-base, not solely on-base.	In the case of Site 5 soils, the area of soils impacted by TCE concentrations in excess of the cleanup goal is completely within the boundaries of the Base. Therefore, use of this term is correct.

COMMENT	RESPONSE
EPA Comments: September 7, 1995	
11. TEXT/SECTION 2.1.2: a. Use of cleanup goals is acceptable for this document, however, NGB must not use the term "goal" in its ROD; the term "cleanup levels" should be used. b. Use of 200 micrograms per liter (µg/l) cleanup goal is acceptable with condition that point of compliance is all ports in all Site 5 vapor monitoring wells and additional VLEACH runs using actual field data. Suggested additional statement on "Allowable Residual Contamination Concentration" (ARCCP). c. Add statement that cleanup levels in this document, and ROD, will be based in 10^{-6} risk.	a. Comment Noted. b. We wish to discuss this comment further prior to revising the FS. b. EPA's condition that a cleanup goal of 200 µg/l must be achieved at <u>all monitoring points</u> is different than the process of evaluating achievement of soil cleanup, as discussed during our June 21, 1995 Technical Progress Meeting at the AANG Base. It is possible that a TCE concentration of 200 µg/l can exist in one or more sampling ports and yet the VLEACH simulations may indicate that ground water protection is achieved. Additionally, we need some clarification regarding the acronyms included in the suggested additional text. Based on our review, the recommended text explaining the ARCCP concept is acceptable. c. The FS will be revised in response to this comment.
12. TEXT/PAGE 2-2: Add the Presumptive Remedy FS support document to the administrative record (AR) and confirm that AR is being compiled.	Comment noted.
13. TABLE 2-1: Use Subpart S cleanup levels.	The Property Action Levels were originally cited in the Remedial Investigation Report. We will substitute Subpart S cleanup levels in this table in accordance with the comment and will update the ARARs discussion accordingly.

COMMENT	RESPONSE
EPA Comments: September 7, 1995	
14. TABLE 2-4: a. Will soil air permeability and moisture be evaluated during the SVE pilot test? b. Verify and correct percent saturation information in table.	a. Yes, these parameters will be evaluated via collection and analysis of samples collected during installation of the pilot extraction well. b. The cited number will be verified and corrected.
15. TABLE 2-4: Add Henry's constant for 1,1,1-TCA.	The table will be revised to include this number.
16. TEXT/Page 3-8: Include estimate of total mass of VOCs in vadose zone. Will 50 foot radius of influence be tested in SVE pilot test?	The estimated mass will be included in the revised FS. Data will be collected during the pilot test will be used to estimate radius of influence of the pilot testing system. These data will be used to help design the full-scale system.
17. FIGURE 3-1: a. Use of 100-500 µg/l contour line is too broad, use 200 µg/l instead. b. VW7 and VW8 are missing.	a. and b.: The figure will be revised in response to these comments.
18. TEXT/PAGE 3-11: a. Change "many years" to "decades" to clarify the no action alternative. b. Explain why exceeding the estimated 5 year period would limit GAC disposition.	a. The FS will be revised in response to this comment. b. The remediation period, as currently anticipated, will be significantly less than 5 years. Therefore, disposal options for spent carbon do not appear to be an issue at this point. The text will be revised accordingly.
17. TEXT/SECTION 3.5: The final version of the FS should recommend one vapor treatment technology and include a discussion of risk reduction.	The FS will be revised to include GAC as the selected vapor treatment technology. We need some further guidance regarding the nature of the requested discussion on risk reduction. The applicability of will be verified during the SVE pilot test.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

September 7, 1995

Mr. Michael Grimm
Air National Guard Readiness Center
ANGRC/CEVR
3500 Fetchet Avenue
Andrews Air Force Base, MD 20331-5157

RE: Headquarters review of NGB Presumptive Remedy Feasibility Study

Dear Mr. Grimm:

EPA has completed its review of the National Guard Bureau document Draft Final Focused Feasibility Study for Site 5 Soils, Tucson International Airport, Tucson, AZ, dated July 1995. EPA finds this document basically well written and apparently in compliance with EPA guidance on Feasibility Studies (FS) and presumptive remedies. Please feel free to contact me at (15)744-2370 if you have any questions or need additional information.

Sincerely,

Loren Henning
Remedial Project Manager

cc: Don Atkinson, ADEQ
Murray Sharkey, ADEQ
Craig Kafura, ADEQ-SRO
Peter Strauss, MHB
Jane Matter, TCE Library

General and specific comments are as follows:

General

1. The document is consistent with EPA "Guidance for Conducting Remedial Investigations and Feasibility Studies" and the "Presumptive Remedy Guidance for Sites With VOCs in Soils."

2. The document presents ERM as the decision maker when the NGB is actually the lead agency at the AANG 162nd base. In this document, EPA views ERM and NGB to be one and the same.

3. Immediate NGB development and implementation of an SVE Pilot Test is acceptable and encouraged by EPA. However, the SVE Pilot Test may not proceed without EPA review and approval of an SVE Pilot Test Work Plan.

4. This draft final document will have to be revised and issued as a final document.

Specific

1. The front cover should state "Tucson International Airport Superfund Site."

2. page vii, 2nd paragraph, 3rd sentence.
Please modify this sentence so that it reflects the fact that no adverse health effects are expected from direct exposure to Site 5 soils (i.e., exposure to surface soils), however, indirectly via transport of VOCs from the subsurface to ground water presents a source of risk.

3. page viii, first paragraph.
Identify EPA Directive 9355.0-48FS as the "Presumptive Remedy Guidance for Sites with VOCs in Soils."

4. page viii, last paragraph, and Section 3.5 on page 3-11
Rewrite document proposing SVE with a specific vapor treatment technology, preferably GAC.

5. page 1-3, Section 1.3.2
This section should specifically acknowledge the use of TCE, TCA and PCE.

6. page 1-7, 2nd paragraph
The TCE acronym is used in this paragraph before it is defined in paragraph 3.

7. page 1-11, Section 1.3.5, first paragraph

I believe you mean "excerpted" and not "excepted."

8. page 1-17, Lower Subunit Ground Water section

Although this section states that the source TCE in the lower subunit is located upgradient, EPA reiterates that Site 5 soils could be contributing to the contamination in the lower subunit.

9. page 1-20, Risk Evaluation section

Please add language to the effect that there is no apparent risk based on direct contact exposure, however, contaminant migration from subsurface soils to ground water does present a source of risk at the site.

10. page 2-2, 2nd paragraph

Just for clarification, the use of the term "on-site" means where contamination has come to be located both on- and off-base, not solely on-base.

11. page 2-3 Section 2.1.2

a. Use of the term "Cleanup Goals" is acceptable for this document. Cleanup goals used in an FS are the same as Preliminary Remediation Goals (PRGs) or Proposed Cleanup Levels. However, the NGB must not use the term "goal" in its ROD. All cleanup goals will be termed required "Cleanup Levels".

b. Use of 200 micrograms/liter (ug/l) cleanup goal is acceptable to EPA with the following stipulations:

- it must be understood that the point of compliance of the 200 ug/l is at each port tested in all three nested vapor monitoring wells in Site 5;
- in order to obtain clearance from EPA that cleanup levels have been achieved, the NGB must attain 200 ug/l at <u>each</u> port in <u>all</u> Site 5 vapor monitoring wells, and obtain one set of modeling results indicating no significant impact (i.e., no exceedences of MCLs) to the upper ground water unit. The modeling results must be based on application of the VLEACH and Mix Cell models using actual field depth-specific soil gas data.

EPA suggests that the following statement be added to Section 2.1.2:

> "Each contaminant shall be removed from target area soils until an Allowable Residual Contamination Concentration (ARCCP) is achieved. An ARCCP is any CCP that will not cause or contribute to ground water contamination in excess of site ground-water cleanup levels."

c. Add statement that all Cleanup Levels in this document are (and will be in the ROD) be based on a 10(-6) risk.

12. page 2-3, last sentence
Please make sure that the August 1994 reference here is

added to NGB's administrative record (AR) for this project. In addition, since the NGB's proposed plan is upcoming, please confirm with EPA that the NGB is currently in the process of compiling an AR in compliance with the NCP and EPA guidance.

13. page 2-4, Table 2-1
EPA has never heard of EPA Property Action Levels, EPA believes that this was meant to be "proposed" action levels. The appropriate federal ARAR in this case are RCRA Subpart S cleanup levels since they are "relevant and appropriate". Please use the Subpart S numbers.

14. page 2-11, Table 2-4
a. Will soil air permeability and soil moisture be evaluated in the SVE Pilot test?
b. EPA Presumptive Remedy guidance for Sites with VOCs in Soil states that SVE is not effective in soil media with greater than 50 percent (not 60%) saturation. Please verify and correct accordingly.

15. page 2-12 Table 2-4
The Henry's constant for 1,1,1-TCA is missing.

16. page 3-18, fourth paragraph
Please include an estimate of total mass of VOCs in vadose zone. Will the 50 foot radius of influence be tested in the SVE Pilot Test?

15. page 3-9, Figure 3-1
a. Use of a 100-500 u/l contour line is too broad. Please use an estimated 200 u/l contour line since that is one of the proposed cleanup levels.
b. VW7 and VW8 are missing.

16. page 3-11, 1st paragraph:

State that the no action alternative will take "decades" since "many" years is not very specific and may be interpreted to mean 5 years or less.

2nd paragraph:

Please explain why exceeding the estimated 5 year period would limit GAC disposition.

17. Section 3.5:
Based on estimated soil gas concentration in Site 5 soils, SVE Pilot Study use of a thermal destruction unit is not warranted. GAC appears to be most suitable for Site 5. The final version of the document should recommend one vapor treatment technology and include a discussion of risk reduction.